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1887-88

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1887-~~1888~~ 91.

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1888.

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REGISTER

OF

THE LEHIGH UNIVERSITY,

SOUTH BETHLEHEM, PA.

1887-1888.

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TUITION FREE.

BETHLEHEM, PA.
THE COMENIUS PRESS.
1888.

TABULAR ALMANAC.

1887.

JULY.

S	M	T	W	T	F	S
...	...	...	...	...	1	2
3	4	5	6	7	8	9
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AUGUST.

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SEPTEMBER.

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OCTOBER.

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NOVEMBER.

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DECEMBER.

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1888.

JANUARY.

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FEBRUARY.

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MARCH.

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JUNE.

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JULY.

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AUGUST.

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SEPTEMBER.

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OCTOBER.

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NOVEMBER.

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DECEMBER.

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1889.

JANUARY.

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FEBRUARY.

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MARCH.

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APRIL.

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MAY.

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JUNE.

S	M	T	W	T	F	S
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23	24	25	26	27	28	29
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CALENDAR.

1887-1888.

1887. Sept. 12, 13, 14,	Monday, Tuesday and Wednesday,	Examinations for Admission.
Sept. 14,	Wednesday,	First Term begins.
Oct. 13,	Thursday,	Founder's Day.
Nov. 24,	Thursday,	Thanksgiving Day.
Dec. 21,	Wednesday,	First Term ends.
1888. Jan. 10, 11,	Tuesday and Wednesday,	Examinations for Admission to Second Term.
Jan. 11,	Wednesday,	Second Term begins.
Jan. 21,	Saturday,	Junior Prize Orations due.
Feb. 15,	Wednesday,	Ash Wednesday.
Feb. 22,	Wednesday,	Washington's Birthday.
March 29,	Thursday,	Easter Holidays begin.
April 3,	Tuesday,	Easter Holidays end at 8¼ A.M.
May 26,	Monday,	University-Day Orations due.
May 30,	Wednesday,	Theses of Seniors due.
May 30,	Wednesday,	Senior Examinations begin
June 6,	Wednesday,	Annual Examinations begin.
June 9,	Saturday,	Senior Examinations end.
June 13, 14, 15,	Wednesday, Thursday and Friday,	Examinations for Admission.
June 17,	Sunday,	Baccalaureate Sermon.
June 19,	Tuesday,	Class Day.
June 20,	Wednesday,	Alumni Day.
June 21,	Thursday,	University Day.

1888-1889.

1888. Sept. 10–12,	Monday, Tuesday and Wednesday,	Examinations for Admission.
Sept. 12,	Wednesday,	First Term begins.
Oct. 11,	Thursday,	Founder's Day.
Nov. 29,	Thursday,	Thanksgiving Day.
Dec. 19,	Wednesday,	First Term ends.
1889. Jan. 8–9,	Tuesday and Wednesday,	Examinations for Admission to Second Term.
Jan. 9,	Wednesday,	Second Term begins.
June 20.	Thursday,	University Day.

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Instructor in Mathematics.

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Instructor in Physics.

PRESTON A. LAMBERT, B.A.,
Instructor in Mathematics.

WILLIAM K. GILLETT, M.A.,
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FONGER DE HAAN, C.N.L.,
Instructor in Modern Languages.

LESTER P. BRECKENRIDGE, PH.B.,
Instructor in Mechanical Engineering.

HENRY S. JACOBY, C.E.,
Instructor in Civil Engineering.

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Instructor in Civil Engineering.

JAMES B. MACKINTOSH, E.M., C.E.,
Instructor in Quantitative Analysis.

CHARLES N. LAKE, PH.C.,
Instructor in Qualitative Analysis and Assaying.

GEORGE F. DUCK, E.M.,
Instructor in Mining.

EDWIN F. MILLER, M.E.,
Instructor in Mechanical Engineering.

FAYETTE B. PETERSEN, C.E.,
Instructor in Metallurgy and Mineralogy.

CHARLES W. MARSH, PH.D.,
Instructor in Organic and Industrial Chemistry.

JOSEPH W. RICHARDS, M.A., A.C.,
Assistant Instructor in Metallurgy and Blowpiping.

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Chaplain,
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J. FRED. WOLLE.

GYMNASIUM.

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CHARLES F. SEELEY.

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A. W. STERNER.

Cataloguing Clerk,
WILSON F. STAUFFER.

Shelf Clerk,
PETER F. STAUFFER.

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Clas.—Classical Course.
L.S.—Latin-Scientific Course.
Sci.—Course in Science and Letters.
Tech.—Technical Course.
A.C.—Analytical Chemistry.
C.E.—Civil Engineering.
E.M.—Mining Engineering.
M.E.—Mechanical Engineering.
Met.—Metallurgy.
Elec.—Electricity.

The students whose names are printed in *italics* are not clear of conditions.

GRADUATES.

	For Degree.	Residence.
Robert Webb Barrell, B.M.,	E.M.,	New Providence, N. J.
Richard Singmaster Breinig, B.M.,	E.M.,	Breinigsville.
Harry Augustus Butler, B.S.,	M.S.,	Mauch Chunk.
Robert Grier Cooke, B.A.,	M.A.,	Bethlehem.
Francis Joseph Crilly, B.A.,	M.A.,	Philadelphia.
William Henry Dean, A.C.,	E.M., M.S.,	Clarence, Iowa.
George Francis Duck, E.M.,	Ph.D.,	Bethlehem.
Milton Henry Fehnel, B.S.,	A.C.,	Bethlehem.
Harvey Sheafe Fisher, B.A.,	M.A.,	Pottsville.
William Kendall Gillett, M.A.,	Ph.D.,	Bethlehem.
William Theodore Goodnow, C.E.,	M.S.,	Birmingham, Ala.
John Daniel Hoffman, B.A.,	M.A.,	Bethlehem.

	Course.	Residence.
Charles Colcock Jones, B.S.,	E.M.,	New Orleans, La.
Preston Albert Lambert, B.A.,	M.A.,	South Bethlehem.
Elmer Henry Lawall, C.E.,	M.S.,	Audenried.
Wilson Franklin More, B.A.,	M.A.,	Catasauqua.
Henry Benj. Chas. Nitze, B.S.,	E.M.,	Baltimore, Md.
George Spencer Patterson, E.M.,	M.S.,	Mahanoy City.
Rufus King Polk, B.S.,	E.M.,	Columbia, Tenn.
George Arthur Ruddle, Ph.B.,	M.A.	E. Mauch Chunk.
Lewis Buckley Semple, B.A.,	M.A.,	Bethlehem.
Harry Harkness Stoek, B.S.,	E.M.,	Washington, D. C.
William Patterson Taylor, B.A.,	M.A.,	Philadelphia.
Leonard Blakslee Treharn, B.A.,	M.A.,	Boston, Mass.
James Hollis Wells, C.E.,	M.S.,	New York, N.Y.
Henry Aug. Julius Wilkens, B.S.,	E.M.,	Baltimore, Md.
Frank Williams, B.S.,	E.M.,	Johnstown.
Wade Hampton Woods, B.S.,	E.M.,	Philadelphia

SENIOR CLASS.

	Course.	Residence.
Charles Lambert Addison,	M.E.,	Reading.
Frank Fielding Amsden,	E.M.,	Scranton.
George Reade Baldwin,	M.E.,	Elmira, N.Y.
Charles Lincoln Banks,	Sci.,	Bridgeport, Conn.
Edmund A. Bates,	C.E.,	Charlestown, W.Va.
William Donaldson Beatty,	C.E.,	Pottsville.
Hubert Alexander Bonzano,	C.E.,	Phœnixville.
William Bradford,	C.E.,	Dover, Del.
Adolph Theodore Bruegel,	M.E.,	Syracuse, N. Y.

	COURSE.	RESIDENCE.
Otto Cornelius Burkhardt,	E.M.,	Bethlehem.
Charles Noble Butler,	C.E.,	Uwchland.
Morton Lewis Byers,	C.E.,	Pittsburgh.
John Jesse Clark,	M.E.,	Corning, N. Y.
George Philip Connard,	C.E.,	Reading.
Augustus Crawford, jr.,	E.M.,	Baltimore, Md.
Reuben Daniels,	C.E.,	Saxton's River, Va.
George Herschel Davis,	C.E.,	Cavendish, Vt.
William Schaff Davis,	C.E.,	Reading.
Philip Hoffecker DeWitt,	C.E.,	Weatherly.
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George Steinman Franklin,	M.E.,	Lancaster.
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Samuel Wilson Frescoln,	C.E.,	Reading.
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Frederick Hayes Knorr,	A.C.,	Philadelphia.
Alfred Eli Lewis, jr.,	E.M.,	Milford.
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Howard Leoser McIlvain,	A.C.,	Reading.

	Course.	Residence.
Charles Henry Miller,	C.E.,	Strasburg.
George Philips Miller,	C.E.,	Lewisburg.
John Hoff Millholland,	C.E.,	Reading.
Harlan Sherman Miner,	A.C.,	Chester, Vt.
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Albert George Rau,	Sci.,	Bethlehem.
Clarence Elmer Raynor,	C.E.,	Manorville, N. Y.
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Eugene Hicks Shipman,	C.E.,	Clinton, N. J.
William Alonzo Stevenson,	M.E.,	Clark's Green.
Wyndham Harvey Stokes,	E.M.,	Gordonsville, Va.
Wilmer Marshall Webb,	M.E.,	Lancaster.
Harvey Musser Wetzel,	C.E.,	Bellefonte.
Winter Lincoln Wilson,	C.E.,	Elkton, Md.
Edward Benjamin Wiseman,	C.E.,	Elmira, N. Y.
Shuntaro Yamaguchi,	C.E.,	Tokio, Japan.
Luther Reese Zollinger,	C.E.,	Harrisburg.

JUNIOR CLASS.

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James Willoughby Anderson,	E.M.,	Washington, D.C.
Pearce Atkinson,	M.E.,	Chicago, Ill.
Gustav Ayres,	M.E.,	Washington, D.C.
Ralph Putnam Barnard,	C.E.,	Washington, D.C.
Albert Harlan Bates,	M.E.,	Cleveland, O.
Samuel Erwin Berger,	Clas.,	Richland Centre.
Charles Hudson Boynton,	L.S.,	Washington, D.C.
Joseph Leander Budd,	A.C.,	Mount Holly, N.J
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Edgar Campbell,	Clas.,	South Bethlehem.
Francis Duncan Campbell,	C.E.,	Kansas City, Mo.
Francis Joseph Carman,	A.C.,	Washington, D.C.
Herbert Mackenzie Carson,	M.E.,	Baltimore, Md.
Leonardo Bravo y Castro,	E.M.,	Santiago de Cuba.
Lansford Foster Chapman,	C.E.,	Catasauqua.
Holden William Chester,	C.E.,	Shamokin.
Charles William Corbin,	E.M.,	Telluride, Col.
William Albert Cornelius,	M.E.,	Philadelphia.
Charles Herbert Deans,	C.E.,	Phœnixville.
Emil Diebitsch,	C.E.,	Washington, D.C.
Charles Estell Dickerson, jr.,	Sci.,	New Germantown, N.J.
John Webster Dougherty,	E.M.,	Steelton.
Ralph Marshall Dravo,	E.M.,	Allegheny.
Albert Edward Duckham,	C.E.,	Pittsburgh.
Ernest Hipolite Du Vivier,	A.C.,	New York City.

	Course.	Residence.
William Dolloway Farwell,	Clas.,	Oswego, N. Y.
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Frederick Louis Grammer,	E.M.,	Baltimore, Md.
George Wentz Harris,	E.M.,	Silver Brook.
Lightner Henderson,	C.E.,	Gap.
Conrad Egbert Hesse,	E.M.,	Washington, D. C.
Clarence Walter Hudson,	C.E.,	Manasquan, N. J.
Arch Johnston,	M.E.,	Bethlehem.
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Arthur Long,	A.C.,	Wilkes-Barre.
John Joseph Martin,	C.E.,	New York, N. Y.
Charles Henry Miller,	A.C.,	Norristown.
Charles Williams Moffett,	M.E.,	Athens, Greece.
Richard Henry Morris, jr.,	E.M.,	Bristol.
William Ellis Morris,	A.C.,	Portland, Ore.
John Thomas Morrow,	M.E.,	Washington, D.C.
Thomas Franklin Newby,	C.E.,	Harrisburg.
Albert Daniel Oberly,	C.E.,	Easton.
Joseph Michael O'Malley,	A.C.,	Wilkes-Barre.
Robert Henry Eddy Porter,	M.E.,	Morristown, N. J.
Arnold Karthaus Reese,	E.M.,	Baltimore, Md.
Abraham Lincoln Rogers,	M.E.,	Fort Wayne, Ind.
Louis Augustus Round,	M.E.,	Providence, R. I.
José Ramon Villalon y Sanchez,	C.E.,	Santiago de Cuba, Cuba.
Charles William Schwartz, jr.,	M.E.,	Germantown.
Arthur Moult Smyth,	E.M.,	Philadelphia.

* Excused.

	Course.	Residence.
Alfred Walton Stockett,	C.E.,	Mauch Chunk.
Lester Clark Taylor,	C.E.,	Pawtucket, R. I.
Augustus Thompson Throop,	C.E.,	Port Gibson, N.Y.
Charles Prentice Turner,	M.E.,	Oxford, N. Y.
Clarence Walker,	E.M.,	Pottsville.
Harry Rush Woodall,	E.M.,	Philadelphia.
Walter Earle Weimer,	A.C.,	Lebanon.
Edward Austin Wright,	C.E.,	Northampton, Mass.
Joseph Bodine Wright,	C.E.,	South Easton.

SOPHOMORE CLASS.

	Course.	Residence.
Howard Emory Alcott,	M.E.,	Mt. Holly, N. J.
George Kerr Anderson,	L.S.,	Franklin.
Thos. Chalkley James Baily, jr.,	C.E.,	Newark, N. J.
George Barclay,	A.C.,	Bethlehem.
Frederick Richard Barrett,	C.E.,	Fort Selden, N. M.
Edwin Herbert Beazell,	C.E.,	Chillicothe, Mo.
Wesley Hudson Beck,	C.E.,	Utica, N. Y.
Herman Stadiger Borhek,	Sci.,	Bethlehem.
Charles Marcus Breder,	E.M.,	Bethlehem.
James W. Boyd,	C.E.,	Seek.
Adolph Cardenas,	C.E.,	Nicaragua.
Charles Baldwin Cassady,	C.E.,	Baltimore, Md.
Morgan Chace,	L.S.,	Elizabeth, N. J.
Frank Riley Chapman,	C.E.,	Steubenville, O.
Holden Thomas Chester,	M.E.,	Williamstown.
Franklin Clarke, Jr.,	M.E.,	Vincennes, Ind.
William Phelps Cleveland,	A.C.,	Waterville, N. Y.

	Course.	Residence.
Frank Raymond Coats,	E.M.,	Philadelphia.
Warren Scott Cope,	C.E.,	Philadelphia.
Charles Ellery Coxe,	E.M.,	Reading.
James Barlow Cullum,	A.C.,	Meadville.
John Rose Davis,	C.E.,	Phœnixville.
Clement Heyser Detwiler,	C.E.,	Ironbridge.
Daniel Edward Downey,	E.M.,	South Bethlehem.
Cornelius Dugan,	A.C.,	South Bethlehem.
Delevan Emery,	A.C.,	Bradford.
Walter Lowe Fairchild,	C.E.,	Hammondsport, N. Y.
Charles Edward Fink,	C.E.,	Harrisburg.
Frederick Elmer Fischer,	C.E.,	New York City.
Frank Roberts Fisher,	C.E.,	Philadelphia.
James William Flack, jr.,	M.E.,	Baltimore, Md.
John George Fleck,	C.E.,	Philadelphia.
Howard Augustus Foering,	Sci.,	Locust Valley.
Robert David Frey,	L.S.,	Centre Valley.
Eugene Uz Gibbs,	M.E.,	Mt. Holly, N. J.
Ralph Goodman,	C.E.,	Atglen.
George Ellsworth Greene,	C.E.,	Rochester, N. Y.
Harry Walter Harley,	M.E.,	Gloucester, N. J.
David Garth Hearne,	C.E.,	Wheeling, W. Va.
Julian Green Hearne,	C.E.,	Wheeling, W. Va.
James Stevens Bush Hollinshead,	E.M.,	Dayton, O.
Paul Depue Honeyman,	L.S.,	Bethlehem.
John Turner Hoover,	C.E.,	Philipsburg.
Frederic Kidder Houston,	M.E.,	New York City.
Alexander Chambers Howard,	E.M.,	Pittsburgh.
Christopher Gadsden Howe,	C.E.,	Charleston, S. C.
Amos Dey Kennedy,	M.E.,	Philadelphia.
Harry Hiram King,	M.E.,	Bethlehem.

	Course.	Residence.
William Vincent Kulp,	C.E.,	Norristown.
Henry Meyers Kurtz,	M.E.,	Allentown.
George Crist Landis,	C.E.,	Middletown.
Harry Kinzer Landis,	E.M.,	Landis Valley.
John Elmer Litch,	M.E.,	Steelton.
Simon Strock Martin,	E.M.,	Steelton.
Allan Moore Masser,	M.E.,	Scranton.
William David Matheson,	A.C.,	Brooklyn, N. Y.
Robert Sayre Mercur,	C.E.,	Wilkes-Barre.
Charles Herbert Miller,	E.M.,	Huntingdon.
Robert Douglas Millholland,	M.E.,	Reading.
Daniel McFarlan Moore,	M.E.,	Bethlehem.
George Nauman, jr.,	C.E.,	Lancaster.
Robert Engler Neumeyer,	C.E.,	Bethlehem.
Albert Nicholson Palmer,	C.E.,	Baltimore, Md.
William Cassidy Perkins,	C.E.,	Williamsport.
Asa Emory Phillips,	C.E.,	Washington, D.C.
Charles Wiltberger Platt,	A.C.,	New York City.
Edward Williams Pratt,	M.E.,	Fort Atkinson, Wis.
Edwin Jay Prindle,	M.E.,	Washington, D.C.
Wallace Carl Riddick,	C.E.,	Wake Forest, N. C.
John Stover Riegel,	M.E.,	Riegelsville, N. J.
Frank Weyman Ritchey,	C.E.,	Pittsburgh.
Joseph Edgar Sanborn,	A.C.,	Bellows Falls, Vt.
Ellis Anstett Schnabel,	Clas.,	Bethlehem.
Harry Johns Sherman,	C.E.,	Mount Holly, N.J.
Stewart Applegate Shimer,	M.E.,	Bethlehem.
William Calvin Shoemaker,	C.E.,	Reading.
Raymond Walton Smith,	C.E.,	Trenton, N. J.
Charles Hugh Stevenson,	C.E.,	Snow Hill, Md.
William Alston Stevenson,	M.E.,	Lewistown.

	Course.	Residence.
Joseph William Stone,	M.E.,	New Orleans, La.
Theodore Alfred Straub,	C.E.	Allegheny.
R. Paul Stout,	M.E.,	Audenried.
Francis Dupont Thomson,	M.E.,	Shanghai, China.
Charles Cookman Tompkinson,	M.E.,	Harrisburg,
Claud Allen Porter Turner,	C.E.,	Lime Rock, R. I.
Aaron Howell Van Cleve,	Sci.,	Easton.
William Alder Webb,	M.E.,	Bethlehem.
Fritz August Weihe,	M.E.,	Wonneberg, W. Prussia.
George Edward Wendle,	M.E.,	Philadelphia.
David Thomas Williams,	M.E.,	Catasauqua.
Herbert Wright,	M.E.,	Northampton, Mass.

FRESHMAN CLASS.

	Course.	Residence.
Hanson Entriken Atkins,	C.E.,	Pottsville.
William Alexander Auchinvole,	A.C.,	Harrisburg.
Murray Blachley Augur,	M.E.,	Washington, D. C.
Hugh Cunningham Banks,	M.E.,	Savannah, Ga.
Juan de la Rosa Barrios,	E.M.,	Bogota, U. S. Colombia.
John Mayall Beaumont,	M.E.	Scranton.
John Bush Beck, Jr.,	M.E.,	Williamsport.
Harry Weed Biggs,	C.E.,	Glendale, O.
Finus Earl Blakeney,	C.E.,	Little Rock, Ark.
James Edwin Boatrite,	C.E.,	Columbus, Ga.
Frederick Carl Bredt,	A.C.,	Bethlehem.
George Briggs,	M.E.,	Scranton.
Jacob Burr Buckley,	M.E.	Oxford, N. Y.
Walter Frederick Burden,	C.E.,	Washington, D. C.

	Course.	Residence.
Frederick Stanley Camp,	M.E.,	Brooklyn, N. Y.
Edwin Chapman,	C.E.,	Catasauqua.
George Vose Chandler,	E.M.,	Washington, D. C.
Emanuel Chao,	C.E.,	Cienfuegos, Cuba.
Henry Clark, Jr.,	E.M.,	Montgomery City, Mo.
John Alexander Colwell,	A.C.,	Kittanning.
James Mosgrove Colwell,	A.C.,	Kittanning.
John Charles Connolly,	M.E.,	South Bethlehem.
Charles Houghton Corbin,	A.C.,	Telluride, Col.
Edward Haviland Coxe,	C.E.,	Reading.
Warden Cresson,	M.E.,	Swarthmore.
Andrew Gilbert Croll,	C.E.,	Weatherly.
Bernard Alphonsus Cullen,	C.E.,	Spruce Creek.
James F. Cullen,	C.E.,	Spruce Creek.
Roland Thomas Davies,	C.E.,	Catasauqua.
Francis Hewette Davis,	M.E.,	Watkins, N. Y.
Frederick Davis,	C.E.,	Watkins, N. Y.
Herman Haupt Davis,	M.E.,	Philadelphia.
Morgan Davis,	E.M.,	Mt. Carmel.
John William DeMoyer,	C.E.,	Houtzdale.
Percival Drayton,	E.M.,	Philadelphia.
Abben Eavenson,	A.C.,	Philadelphia.
Harry S. Eckert,	A.C.,	Reading.
William Parker Ely,	C.E.,	Lambertville, N. J.
Fitz Daniel Ermentrout,	L.S.,	Reading.
Juan de la Cruz Escobar,	M.E.,	Matanzas, Cuba.
Walter Famaris,	C.E.,	Beverly, N. J.
Willis E. Fertig,	L.S.,	Titusville.
Arthur Haldeman Fetters,	M.E,	Barneston.
George Buchanan Fife,	C.E.,	Washington, D. C.
Harry Alton Fitzjarrell,	C.E.,	Easton, Md.

	Course.	Residence.
Walton Forstall,	M.E.,	Chicago, Ill.
Harry Fulmer,	C.E.,	Philadelphia.
Samuel Morrison Graham,	M.E.,	Phillipsburg.
John Stilwell Griggs,	M.E.,	Lakeville, Conn.
Irwin Lorenzo Hartman,	C.E.,	Hockendauqua.
George Samuel Hayes,	Sci.,	Painesville, O.
John Sidney Heilig,	M.E.,	Catasauqua.
John Franklin Hersh,	C.E.,	Allentown.
Hermann Victor Hesse,	E.M.,	Bethlehem.
Ralph Ridgway Hillman,	C.E.,	Wilkes-Barre.
William Ross Hillyer,	M.E.,	Port Richmond, N.Y.
Benjamin William Homans,	C.E.,	Brooklyn, N. Y.
William Jennings,	C.E.,	Harrisburg.
William Edward Johnson,	C.E.,	Glastonbury, Conn.
Juan Jose Jimenez,	C.E.,	Aguadilla, Porto Rico.
Henry Kemmerling,	C.E.,	Scranton.
Hermann Meriwether Knapp,	C.E.,	Louisville, Ky.
Harry Kramph,	C.E.,	North Platte, Neb.
Herbert Gilfillan Lamberton,	C.E.,	Franklin.
John LeDroit Langdon,	E.M.,	Buffalo, N. Y.
Frederic Curtiss Lauderburn,	Clas.,	Hazleton.
George Edwin Lefevre,	E.M.,	Panama, U.S.Colombia.
Henry Lefevre,	E.M.,	Panama, U.S.Colombia.
Charles McKnight, Leoser, jr.,	E.M.,	New York City, N. Y.
Frank King Leslie.	A.C.,	Sharon.
Henry Washington Lloyd, jr.,	M.E.,	Stanhope, N. J.
Joseph Simonson Lockwood,	M.E.,	Brooklyn, N. Y.
Nevin John Loos,	E. M.	Bethlehem.
Robert Montgomery Loper,	C.E.,	Bridgeton, N. J.
George Hillard Lynch,	C.E.,	Wilkes-Barre.
Joseph Macfarland,	A. C.,	Washington, D. C.

	Course.	Residence.
George Evans Meily,	A.C.,	Lebanon.
Victoriano Mendozo,	C.E.,	Gaudalajara, Mex.
John Zollinger Miller,	M.E.,	Harrisburg.
George Smuller Mish,	C.E.,	Middletown.
Frederick Kent Morris,	Sci.,	Moorestown, N. J.
Harry Timothy Morris,	M.E.,	Pottsville.
Horatio Whitemore Myrick,	Sci.,	Springfield, Mass.
Frank Hamilton McCall,	M.E.,	Binghamton, N. Y.
Alexander Leutze McClurg,	E.M.,	Chambersburg.
James Anderson McClurg,	C.E.,	Meadville.
Henry Stewart McKee,	E.M.,	Washington, D. C.,
Paul Mayo Paine,	C.E.,	Troy.
William Taylor Patterson,	M.E.,	Mahanoy City.
Joaquin Prieto,	M.E.,	Bogota, U. S. Colombia.
Edwin Addams Quier,	A.C.,	Reading.
James Pius Rafferty,	M.E.,	Chicago, Ills.
Edgar Randolph Reets,	C.E.,	Wilkes-Barre.
Walter Freeman Rench,	C.E.,	Cumberland, Md.
Wallace Chester Rice,	C.E.,	Bridgeton, N. J.
John Ira Riegel,	C.E.,	South Bethlehem.
Milton Holly Robbins, jr.,	M.E.,	Lakeville, Conn.
Robert Schmitz,	C.E.,	Egg Harbor City, N. J.
Anton Schneider,	C.E.,	Summit Hill.
Leidy Rudy Shellenberger,	C.E.,	Benjamin.
Frank William Brown Schutte,	A.C.,	Philadelphia.
Ira Augustus Shimer,	Clas.,	Redington.
Charles Henry Simpson,	C.E.,	Pensacola, Fla.
James Vincent Smith,	M.E.,	Franklin.
Matthew Charles Smith,	C.E.,	Birmingham, Ala.
Oscar Emmerson Smith,	C.E.,	Portsmouth, Va.
Michael Druck Sohon,	A.C.,	Washington, D. C.

	Course.	Residence.
William Buchecker Spengler,	M.E.,	Bethlehem.
Horace Theodore Stillson,	C.E.,	Cleveland, Ohio.
Mercer Brown Tate,	C.E.,	Middletown.
William Sidney Topping,	L.S.,	Sagg, N. Y.
Edwin Smith Townsend,	Sci.,	New York City, N. Y.
Domingo Anthony Usina,	C.E.,	Savannah, Ga.
Michael Neligan Usina,	M.E.,	Savannah, Ga.
Elias Vander Horst,	M.E.,	Charleston, N. C.
Henry Wadleigh,	Sci.,	South Bethlehem.
Joseph Wickes Welsh,	C.E.,	Washington, D. C.
Frank Shriver West,	A.C.,	Philadelphia.
Francis Nichols Whitney,	M.E.,	Pottsville.
George Brown Zahniser,	C.E.,	Mercur.
Roger Hanson Zimmerman,	E.M.,	Louisville, Ky.

ELECTRICALS.

	Residence.
Ira Ayer,	San Francisco, Cal.
Albert Brodhead,	Bethlehem.
Joseph Edwin Cochran,	Emporium.
William Fairchild Dean,	Seymour, Conn.
Frank Ross Durant,	Morristown, N. J.
John Clark Finney,	Milwaukee, Wis.
Chester Lyon Forsman,	Williamsport.
Herman Frauenthal,	Wilkes-Barre.
Richard Otto Albert Heinrich,	Gotha, Germany.
Joseph Allison Horner,	Bath.

	Residence.
William Henry Hubbard,	Beaver Falls.
Daniel Henry Jenkins,	Edwardsdale.
Charles Jacob Miller,	Bethlehem.
James Leidy Moore,	Moorestown, N. J.
Wilbur Wellesley Parker,	Bridgewater, Nova Scotia.
Charles Norris Robinson,	Germantown.
John Percy Ryon,	Pottsville.
Robert Crittenden Segur,	Morristown, N. J.
Harry Meyer Seitzinger,	Wilkes-Barre.
William Augustus Stedman,	New York, N. Y.
Charles Wesley White,	Utica, N. Y.
John Brinton Whitehead,	Pittsburgh.
Hugh Carlyle Young,	Wellsboro.

SPECIAL STUDENTS.

	Course.	Residence.
Allen Harwood Babcock,	A.C.,	Oakland, Cal.
Henry M. Byllesby,	M.E.,	New York, N. Y.
Henry Clinton Carter, B.S.,	A.C.,	New York, N. Y.
Charles Joseph Coll.	C.E.,	Broad Ford.
Wallis Eastburn Howe,	C.E..,	Reading.
Albert Edward Juhler,	A.C.,	Pomeroy, Ohio.
Edwin Kamerly MacNutt,	A.C.,	Wilkes-Barre.

SUMMARY OF STUDENTS BY CLASSES.

Graduates,	28
Seniors,	66
Juniors,	65
Sophomores,	91
Freshmen,	121
Students in Advanced Electricity,	23
Specials,	7
Total,	401

SUMMARY OF STUDENTS BY STATES.

Vermont,	3
Massachusetts,	4
Connecticut,	5
Rhode Island,	4
New York,	39
Pennsylvania,	212
New Jersey,	24
Delaware,	2
Maryland,	19
District of Columbia,	19
Virginia,	3
West Virginia,	4
South Carolina,	1
Georgia,	5
North Carolina,	2
Alabama,	2

Florida,	1
Louisiana,	2
Ohio,	8
Indiana,	2
Illinois,	3
Arkansas,	1
Wisconsin,	2
Iowa,	1
Missouri,	3
Kentucky,	2
Tennessee,	1
Kansas,	1
Colorado,	2
California,	2
Oregon,	1
Nebraska,	1
Mexico,	1
New Mexico,	1
Nicaragua,	1
Nova Scotia,	1
Porto Rico,	2
Cuba,	4
Jamaica,	1
England,	1
Greece.	1
United States of Colombia,	4
China,	1
Japan,	1
Germany,	2
Total,	401

SUMMARY OF STUDENTS BY COURSES.

SCHOOL OF GENERAL LITERATURE.

Classical Course,	19	
Latin-Scientific Course,	10	
Course in Science and Letters,	11	
		40

SCHOOL OF TECHNOLOGY.

Course in Civil Engineering,	148	
Course in Mechanical Engineering,	91	
Course in Mining Engineering,	56	
Course in Electrical Engineering,	23	
Course in Analytical Chemistry,	43	
		361
Total,		401

THE LEHIGH UNIVERSITY.

ORIGIN.

The Hon. Asa Packer, of Mauch Chunk, during the year 1865, appropriated the sum of Five Hundred Thousand Dollars, to which he added one hundred and fifteen acres of land in South Bethlehem, to establish an educational Institution in the rich and beautiful Valley of the Lehigh. From this Foundation rose The Lehigh University, incorporated by the Legislature of Pennsylvania in 1866. In addition to these gifts, made during his life-time, Judge Packer by his last will secured to the University an endowment of $1,500,000, and to the University Library one of $500,000.

DESIGN.

The original object of Judge Packer was to afford the young men of the Lehigh Valley a complete technical education for those professions which had developed the peculiar resources of the surrounding region. Instruction was to be liberally provided in Civil, Mechanical and Mining Engineering, Chemistry, Metallurgy, and in all needful collateral studies. French and German were made important elements in the collegiate course. A School of General Literature was part of the original plan, together with tuition in the ancient Classics.

FREE TUITION.

All these educational facilities are provided without charge. Through the generosity of the Founder, the Trustees were enabled, in 1871, to declare tuition FREE in all

branches and classes. The Lehigh University is open to young men of good character and suitable preparation from every part of our own land and of the world. To this fact the attention of the pupils of our public schools and of the graduates of classical institutions is especially called. Thus is offered, *without charge*, every facility for studying the professions of the Civil, Mechanical, Mining and Electrical Engineer, and of the Metallurgist and Analytical Chemist. In the Classical and Scientific departments of the School of General Literature instruction is given in the Classics, Sciences and Letters.

PUBLIC WORSHIP.

Prayers are held in the Packer Memorial Church of the University every morning and all students are required to be present.

Divine Service is held on every Sunday morning in the Church. The service is according to the forms of the Protestant Episcopal Church, under whose auspices the University was placed by its Founder. Attendance is required of every student, except in case of those connected with other religious bodies, to whom the President will grant permission at the beginning of each term (if requested by the parent or guardian, or by the student himself if he be 21 years of age) to attend during that term the place of worship of the body with which he is connected, where attendance on Sunday morning will be required.

SITE.

The situation of the Institution is healthful and beautiful. The region is famous for its railway and manufacturing enterprises; it possesses some of the richest iron and coal mines in our land, and thus gives the students rare facilities for confirming the teachings of the recitation room by the observation of the eye.

The University Buildings are about a half-mile from the depot, at the junction of the Lehigh Valley and North Pennsylvania Railroads. New York is ninety-two, and Philadelphia fifty-four miles distant.

BUILDINGS.

PACKER HALL,

named after the Founder, stands seven hundred feet back of Packer Avenue, at the base of the South Mountain. It is built of stone, and contains Lecture and Recitation Rooms, the Drawing Rooms and the Museum of Geology and Natural History.

THE CHEMICAL LABORATORY

is thoroughly fire-proof, is built of sandstone, and is 219 feet in length by 44 in width.

There are two principal stories and a basement. The upper floor is occupied by the quantitative and the qualitative chemical laboratories, the former accommodating 48 and the latter 84 students. These rooms are 20 feet in height, and are well lighted and ventilated. A laboratory for industrial chemistry and the supply room are also on this floor.

The first floor contains a large lecture room, a recitation room, a chemical museum and laboratories for organic, physiological, agricultural and sanitary Chemistry.

In the basement is the large laboratory for the furnace assay of ores and a well appointed laboratory for gas analysis, also rooms containing the apparatus for several processes in industrial chemistry, the engine and air-pump for vacuum filtration, a store room and the toilet.

A photographic laboratory is located in the third story of the central portion of the building.

THE METALLURGICAL LABORATORY

contains a lecture room, a blowpipe laboratory for class instruction in blowpipe analysis and in the practical determination of crystals and minerals, a museum for mineralogical and metallurgical collections, a mineralogical laboratory provided with a Fuess reflecting goniometer, a polariscope, a Groth's "universal apparat" and a Rosenbusch polarizing microscope, a dry laboratory provided with furnaces for solid fuel and for gas with natural draught and with blast,

and a wet laboratory for ordinary analytical work. It is arranged for the instruction of classes in the courses of mineralogy, metallurgy and blowpipe analysis of the regular curriculum, and to afford facilities to a limited number of advanced students to familiarize themselves with the methods of measurement and research employed in mineralogy and metallurgy, and to conduct original investigations in these departments of science.

THE PHYSICAL LABORATORY

consists of three stories. A large lecture room with a seating capacity of 150, occupies a portion of the second and third floors. It is well lighted and adapted to its purposes. On the remainder of these floors are two rooms, each 40 feet long, for Heat and Light laboratories, a dark room for photographic work, spectroscopic and apparatus rooms and the private laboratories of the instructors.

The lower floor is devoted to the use of the students in Electricity. A large room nearly 40 feet square is used as the Electrical Laboratory. There are smaller rooms for photometric and spectroscopic work, also reading, balance, apparatus and engine rooms. On this floor a 12 horse-power high speed engine and a dynamo supply two systems of electric lights, one of 25 incandescent lamps, the other of four arc lights, for practical tests in the Electrical Laboratory and for experimental purposes in the lecture room above. In the cellar are battery, store rooms, etc.

The tower and two rooms in the east end of Christmas Hall have been given to the Departments of Physics and will be equipped as a Meteorological Observatory.

THE SAYRE OBSERVATORY.

Near Brodhead Avenue is the Sayre Observatory, the gift of Robert H. Sayre, Esq., of South Bethlehem, containing an equatorial and a zenith telescope, transit instrument and astronomical clock.

THE UNIVERSITY LIBRARY.

To the east of Packer Hall is the University Library, erected by the Founder in memory of Mrs. Lucy Packer Linderman, his daughter.

THE GYMNASIUM

is a handsome and spacious structure, built and equipped with the utmost thoroughness. It is furnished with the best patterns of gymnastic apparatus, besides Dr. Sargent's system of Developing Appliances. It is provided with hot and cold water; tub, sponge and shower baths, and 329 clothes closets. Opportunities for recreation and amusement are provided in the billiard room and bowling alleys. It is under the immediate care of a skilled and competent Director.

All students are required to undergo a physical examination before being allowed the use of the Gymnasium, and this examination will be repeated once each year during their stay at the University. The proper exercise is prescribed and is required of every student. The aim of the Institution is to promote a harmonious symmetrical development best suited to the individual condition of the student.

EXPENSES.

Tuition is FREE in all branches and classes. Books, materials, paper, pencils, chemical materials used in the analytical laboratory and drawing instruments, are furnished by the student.

Rooms and Board can not be had in University buildings, but can readily be obtained in many private houses.

The following is an estimate of the necessary expenses for the collegiate year, clothing and traveling not included:

Board for 40 weeks, . . .	from $160 to $200
Room-rent, with fuel and lights .	40 " 80
Care of room and use of furniture,	5 " 20
Washing and incidentals, . . .	20 " 40
Books, stationery, etc., . . .	25 " 50
Total, ...	$250 to $390

NOTE.—If clubs be formed the cost of board need not exceed $3.50 per week.

ADMISSION OF STUDENTS.

ENTRANCE EXAMINATIONS.

Application for admission should be made to the President of the University, from whom all information may be obtained.

DATE OF EXAMINATIONS.

Examinations for admission to the University are held at the opening of each term, and also in June at the close of the Academic year.

The examinations for 1888 will be on Tuesday and Wednesday, January 10 and 11, for admission to the *second term*; on Wednesday, Thursday and Friday, June 13, 14 and 15, and on Monday, Tuesday and Wednesday, September 10, 11 and 12, for admission to the first term. No other examinations for entrance will be held, except for good cause, and all applicants *must* be in attendance at 8.30 on the morning of the first day.

The examinations are held in the following order:

First Day.—English Grammar, 9.00 A.M.; Geography, 11.30 A.M.; United States History, 2 P.M.; Physical Geography, 4 P.M.

Second Day.—Geometry, 9 A.M.; Arithmetic, 2 P.M.; Algebra, 3.30 P.M.

Third Day.—Latin and Roman History; Elementary Physics, 8.30 A.M.; Greek and Greek History, 2 P.M.

CHARACTER OF THE EXAMINATIONS.

The examinations are rigorous and cover the entire ground laid down in the following scheme. They are all conducted in writing, supplemented by an oral examination at the option of the examiner.

All candidates for admission must be at least sixteen years of age, must present testimonials of good moral character, and, must satisfactorily pass in the following subjects:

1. *English Grammar*, including composition, spelling and punctuation. It is recommended that candidates have a knowledge of Latin Grammar, although an examination in it is not required for any courses except the Classical and the Latin-Scientific.

2. *Geography*, general and political.

3. *History of the United States*, including the *Constitution*.

4. *Arithmetic*, including the metric system of weights and measures.

5. *Algebra*, Fundamental Principles. Factoring. Least Common Multiple. Greatest Common Divisor. Fractions. Involution. Evolution. Radicals. Imaginary Quantities. Equations of the First and Second Degrees. Ratio. Proportion and Progressions.

[Olney's University Algebra is recommended, as it is the text-book used in the University.]

6. *Geometry*, Fundamental Principles. Rectilinear Figures. The Circle. Proportional Lines and Similar Figures. Comparison and Measurement of the Surfaces of Rectilinear Figures. Regular Polygons. Measurement of the Circle. Maxima and Minima of Plane Figures. The Plane and Polyhedral Angles.

[Chauvenet's Geometry, (six books) is recommended, as it is the text-book used in the University.]

For admission to the various courses, *in addition* to the requirements above given, the examinations are as follows:

For the Course in Science and Letters, Civil, Mechanical, Mining and Electrical Engineering, and Analytical Chemistry.

7. *Elementary Physics.*

[Avery's Elements of Natural Philosophy (revised edition) is recommended.]

For the Latin-Scientific and Classical Courses.

8. *Physical Geography.*

9. *Latin Grammar*, (Harkness' preferred).

10. *Cæsar*, four books of the Gallic war.

11. *Cicero*, six orations, including the four against Cataline.

12. *Virgil*, the Bucolics and the first six books of the Aeneid, including Prosody.

13. The translation, at sight, of passages from Cæsar and Cicero.

14. The translation of English into Latin. (As special importance is given this part of the examination, it is suggested to teachers that they connect exercises in making Latin, both oral and written, with all the studies of the preparatory course.)

15. *Roman History.* Creighton's Primer of Roman History is suggested as indicating the amount required.

For the Classical Course only.

16. *Greek Grammar*, (Goodwin's preferred).

17. *Xenophon*, Anabasis, four books.

18. *Homer*, Iliad, three books, including Prosody.

19. The translation, at sight, of a passage from some work of Xenophon.

20. *Greek History.* Fyffe's Primer of Greek History is suggested.

21. Writing Greek with accents.

The pronunciation of Greek according to the written accents is followed in the University, and it is desirable that students preparing to enter be taught this system.

Division of Entrance Examinations.

Candidates for admission to the Freshman Class may pass all the examinations *at once* in June, or in September, or may take them in *two consecutive years.* In the latter case for the Technical courses and the course in Science and Letters, candidates may present themselves for examination in the first year in the following subjects: English

Grammar, Geography, History of the United States, and Arithmetic. No credit will be given unless the candidate has passed satisfactorily in at least three subjects at one examination.

The examinations in Algebra, Geometry and Physics must be passed in June or September of that year in which the candidate proposes to enter the University.

In the Latin-Scientific and Classical courses candidates may present themselves for examination in the first year in the following subjects: English Grammar, History of the United States, Arithmetic, Physical Geography, and Roman History. No credit will be given unless the candidate has passed at least four of the subjects at one examination.

The examination in Latin may also be divided, but no credit will be given unless the candidate has passed in at least three of the topics specified at one examination. The examination in the remaining subjects must be passed in June or September of that year in which the candidate proposes to enter the University.

Candidates intending to enter the University in September are advised to present themselves for examination in June; if they are not fully prepared at that time they will receive credit for the examinations then satisfactorily passed.

CONDITIONAL ADMISSION.

A candidate failing to pass in one or more of the subjects required for admission may, at the discretion of the Faculty, be admitted to his class conditionally, to make up his deficiencies by extra study. When they are made up, he will be received into full standing in his class.

SPECIAL STUDENTS.

Young men who do not desire to take a full regular course can enter and select special shorter courses, with the sanction of the Faculty; but in all cases satisfactory examinations must be passed upon the subjects required for admission to the Freshman class.

ADMISSION TO ADVANCED STUDIES.

Candidates for admission to advanced studies *in any course* are required to pass, *in addition to the entrance examinations for that course*, examinations in the work already done by the classes which they desire to enter. These examinations are held on the same days as those for admission to the Freshman class.

The additional subjects may be found in the programme of studies.

A diploma or, in so far as it covers the subjects required for admission, a certificate of studies taken at another College will be received in lieu of the *Primary Entrance Examinations only.*

ADMISSION TO THE POST GRADUATE COURSE.

Students of this University who have taken their *first* degree, and others, on presenting a diploma of an equivalent degree conferred elsewhere, are admitted to advanced studies, according to the plan to be found under the general subject of Graduate Students.

PREPARATORY SCHOOL CERTIFICATES

are not accepted so as to dispense with the primary entrance examination.

NOTE.—The acceptance of a certificate as evidence of proficiency in lieu of examination, is at the discretion of each Professor as to the subjects in his department.

PROGRAMME OF STUDIES,

Showing the number of exercises per week for each subject, and the Text-books used.

The following is presented as the general programme of instruction, subject to such modifications from time to time as the Faculty may deem expedient, with the approval of the Trustees.

The names of the text-books studied are generally mentioned. The number of exercises per week in each subject is indicated by the figure in parentheses immediately following.

Two hours of Drawing, three of work in the Laboratory, or three of practice in the field, are regarded as equivalent to a recitation or lecture of one hour's duration.

During the year, Prof. Ringer will deliver a course of lectures on the History of Europe, from the Congress of Vienna in 1815 to the Congress of Berlin in 1878.

SCHOOL OF GENERAL LITERATURE.

This school is intended to correspond to the course long established in our older colleges, modified by the needs and requirements of modern culture. Its object is to impart a comprehensive and liberal education to those who design to enter upon professional rather than technical pursuits.

It comprises three distinct courses:

I.—The Classical Course or Course in Arts.

II.—The Latin-Scientific Course or Course in Philosophy.

III.—The Course in Science and Letters.

THE CLASSICAL COURSE.

This course is chiefly designed for those who purpose to study Law and Theology; it includes full and rigorous in-

struction in the Ancient Classics, in Elementary Science and in General Literature. The study of Mathematics in this course embraces Algebra, Geometry, Trigonometry, Analytical Geometry, and the Calculus. The programme includes Physics, Chemistry and Elementary Mechanics. There are full courses in History, in the Science of Language and in the origin and growth of the English Language. There are also lectures on Psychology, the Christian Evidences, International and Constitutional Law and Political Economy. Lectures on English Literature are supplemented by critical readings of the standard English authors. The graduate in this course obtains the degree of Bachelor of Arts (B.A.).

FRESHMAN CLASS.

FIRST TERM.

Mathematics.—Geometry (Chauvenet) completed. (4)
Chemistry.—Lectures. Fownes' Elementary Chemistry. (4)
Greek.—Homer: Odyssey. Prosody. (3)
Latin.—Livy. Prose Composition. (2)
History.—History of Greece. (1)
Physiology and Health.—Lectures. (1)
English.—Exercises and Declamations. (1)
Gymnasium. (2)

SECOND TERM.

Mathematics.—Olney's University Algebra, Pt. III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic tables. (2)
Greek.—Xenophon: Oeconomicus. (3)
Latin.—Cicero: De Amicitia. Horace: Odes and Epodes. Composition and Prosody. (4)
History.—History of Greece. (2) History of Rome. (1)
English.—Exercises and Declamations. (1)
Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry. Olney's General Geometry. (4)

Physics.—Lectures. (3)

French.—Chardenal. Keetel's Analytical Reader. Written and Oral Translations. (2) Or *German.*—Brandt's Grammar. Lodeman's Manual of Exercises. Joynes' Otto's Reader. (2)

Greek.—Herodotus. (2)

Latin.—Tacitus: Agricola and Germania. Composition. (2)

History.—History of Rome. (2)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics.—Differential and Integral Calculus: Olney. (4)

French. — Grammar. Chardenal's French Exercises. Reader (continued). (2) Or *German.*—Grammar. Exercises and Reader (continued). (2)

English.—Coppée's Rhetoric, with Kellogg's Praxis. (1)

History.—Outlines of the World's History. (2)

Greek.—Euripides: Medea. (3)

Latin.—Quintilian: Book X. Horace: Satires and Epistles. Composition. (3)

Essays and Declamations. (1)

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

History.—Outlines of the World's History. (2)

Philosophy.—Coppée's Logic (2)

English.—Coppée's English Literature. (4)

French.—Grammar. Chardenal's Exercises. Written and Oral Translations. Chapsal: Littérature Française. (2) Or *German.*—Grammar. Translation from German into English and *vice versa.* Reading. (2)

Greek.—Sophocles: Electra. Antiquities. (3)

Latin.—Plautus and Terence. Roman Antiquities: Wilkins. (3)

Literature and History. (1)

Gymnasium. (2)

SECOND TERM.

History.—History of England: Hume. (3)

Philosophy.—Porter's Elements of Intellectual Science. (2) Political Economy. (1)

English.—Earle's Philology of the English Tongue. (2)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Gasc's Translator. Dictation. (2) Or *German.*—Grammar. Systematic Reading of various authors. Translation. Dictation. (2)

Greek.—Aristophanes: Clouds. (3)

Latin.—Juvenal and Persius. Pliny: Select Epistles. Cruttwell's History of Roman Literature. (3)

Essays and Original Orations. (1)

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

International Law.—Lectures: Woolsey. (2)

History.—Decline and Fall of the Roman Empire: Gibbon. (3)

Philosophy.—Moral Philosophy. (2)

Astronomy.—Loomis' Treatise, with Lectures. (3)

French.—Grammar. Saintsbury: Specimens of French Literature. Corneille; Racine; Molière; Contemporary authors. Lectures on French Literature. Compositions. (2) Or *German.*—Grammar. Systematic Readings. Ger-

man Compositions. Lectures on German Literature. (2) Conversation Class in both languages optional.

Greek.—Pindar: Selected Odes. Greek Literature. (2)

Latin.—Lucretius, with Lectures. Roman Literature. (2)

Essays and Original Orations. (1)

Gymnasium. (2)

SECOND TERM.

Constitutional Law.—Lectures. (1)

History.—History of France. (2)

Philosophy.—History of Philosophy. (1) Philosophy of History. Lectures. (2)

Christian Evidences. (1)

French.—Systematic Readings. Compositions. Lectures on French Literature. Lectures in French on Modern French Authors. (2) Or *German.*—Systematic Readings. German Composition. Lectures on German Literature. Lectures in German on Modern German Authors. (2)

Geology.—Lectures. Le Conte. (2)

Greek.—Thucydides. Greek Literature completed. (2)

Latin.—Catullus, Tibullus and Propertius. Cicero: de Officiis, with Lectures. Roman Literature (completed). (2)

Lectures on American and English Literature. (2)

Preparation of Thesis.

Gymnasium.

THE LATIN SCIENTIFIC COURSE.

The Latin-Scientific Course leading to the degree of Bachelor of Science (B.S.) is based on Latin without Greek.

FRESHMAN CLASS.

FIRST TERM.

Mathematics.—Geometry (Chauvenet) completed. (4)

Chemistry.—Lectures. Fownes' Elementary Chemistry. (4)

German.—Brandt's Grammar. Lodeman's Manual of Exercises. Writing in German Text. Translation into English. (3)

Latin.—Livy. Prose Composition. (2)
History.—History of Greece. (1)
Physiology and Health.—Lectures. (1)
English.—Exercises and Declamations. (1)
Gymnasium. (2)

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of the Logarithmic Tables. (2)
German.—Brandt's Grammar. Lodeman's Manual of Exercises. Translations: Joynes' Otto's German Reader. (3)
History.—History of Greece. (2) History of Rome. (1)
Latin.—Cicero: De Amicitia. Horace: Odes and Epodes. Composition and Prosody. (4)
English.—Exercises and Declamations. (1)
Gymnasium. (2.)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4.)
Physics.—Lectures. (3)
French.—Chardenal. Keetel's Analytical Reader. Written and Oral Translations. (2)
German.—Brandt's Grammar. Lodeman's Manual of Exercises. Translations from German into English. (2)
History.—History of Rome. (2)
Latin.—Tacitus: Agricola and Germania. Composition. (2)
English.—Exercises and Declamations. (1)
Gymnasium. (2)

SECOND TERM.

Mathematics. — Differential and Integral Calculus: Olney. (4)

English.—Coppée's Rhetoric, with Kellogg's Praxis. (1)

French. — Grammar. Chardenal's French Exercises. Reader (continued). (2)

German. — Grammar. Systematic Readings of various authors. Translation. Dictation. (2)

History.—Weber's Outlines of the World's History. (2)

Latin. — Quintilian: Book X. Horace: Satires and Epistles. Composition. (3)

Essays and Declamations. (1)

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

History.—Weber's Outlines of the World's History. (2)

Philosophy.—Coppée's Logic. (2)

English.—Coppée's English Literature. (4)

French.—Grammar. Chardenal's Exercises. Written and Oral Translations. Chapsal: Littérature Française. (2)

German.—Systematic Readings of various authors. Lessing, Herder, Goethe, Schiller. Dictation. Compositions in German. (2)

Latin. — Plautus and Terence. Roman Antiquities: Wilkins. (3)

Literature and History. (1)

Gymnasium. (2)

SECOND TERM.

History.—History of England: Hume. (3)

Philosophy.—Porter's Elements of Intellectual Science. (2) Political Economy. (1)

English. — Earle's Philology of the English Tongue. (2)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Gasc's Translator. Dictation. (2)

German.—Systematic Reading of various authors (continued). Dictation. Compositions in German. (2)

Latin.—Juvenal and Persius. Pliny: Select Epistles. Cruttwell's History of Roman Literature. (3)

Essays and Original Orations. (1)

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

International Law.—Lectures: Woolsey. (2)

History.—Decline and Fall of the Roman Empire: Gibbon. (3)

Philosophy.—Moral Philosophy. (2)

Astronomy.—Loomis' Treatise, with Lectures. (3)

French.—Grammar. Saintsbury: Specimens of French Literature. Corneille; Racine; Molière; Contemporary authors. Lectures on French Literature. (2)

German.—Systematic Readings of various German authors (continued). Lectures on German Literature. Compositions. (2) Conversation Class in both languages optional.

Latin.—Lucretius, with Lectures. Roman Literature. (2)

Essays and Original Orations. (1)

Gymnasium.

SECOND TERM.

Constitutional Law.—Lectures. (1)

History.—History of France. (2)

Philosophy.—History of Philosophy. (1) Philosophy of History. Lectures. (2)

Christian Evidences. (1)

Geology.—Lectures. Le Conte. (2)

Latin.—Catullus, Tibullus and Propertius. Cicero: de Officiis, with Lectures. Roman Literature (completed). (3)

French.—Systematic Readings. Compositions. Lectures on French Literature. Lectures in French on Modern French authors. (2)

German.—Lectures on German Literature. Lectures in German on Modern German authors. Compositions. (1)

Lectures on American and English Literature. (2)

Preparation of Thesis.

Gymnasium.

A COURSE IN SCIENCE AND LETTERS.

The Course in Science and Letters, leading to the Degree of Bachelor of Science (B.S.), is designed for those who wish to pursue both Scientific and Literary studies without Latin and Greek. These being omitted, extended instruction is given in French and German, History, General Literature, Mathematics and General Science.

FRESHMAN CLASS.

FIRST TERM.

Mathematics.—Geometry, (Chauvenet) completed. (4)

Chemistry.—Lectures. Fownes' Elementary Chemistry. (4)

German.—Brandt's Grammar. Lodeman's Manual of Exercises. Writing in German Text. Translation into English. (3)

Drawing.—Elementary Projections, Shading and Lettering. (2)

History.—History of Greece. (1)

Physiology and Health.—Lectures. (1)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of the Logarithmic Tables. (2)

Chemistry.—Qualitative Analysis. (3)

History.—History of Greece. (2) History of Rome. (1)

German.—Brandt's Grammar. Lodeman's Manual of Exercises. Translation. Joynes' Otto's German Reader. (3)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)

Physics.—Mechanics, Heat and Electricity. Lectures. (5)

French.—Chardenal. Keetel's Analytical Reader. Written and Oral Translations. (2)

German.—Brandt's Grammar. Lodeman's Manual of Exercises. Translations from German into English. (2)

History.—History of Rome. (2)

English.—Exercises and Declamation. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics. — Differential and Integral Calculus: Olney. (4)

Physics.—Sound, Light and Meteorology. Lectures. (3)

English.—Coppée's Rhetoric, with Kellogg's Praxis. (1)

French.—Chardenal. Keetel's Analytical Reader. Written and Oral Translations. (2)

German.—Grammar. Systematic Readings of various authors. Translation. Dictation. (2)

History.—Outlines of the World's History. (2)

Essays and Declamations. (1)

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

History.—Outlines of the World's History. (2)

Philosophy.—Coppée's Logic. (2)

English.—Coppée's English Literature. (4)

French.—Grammar. Chardenal's Exercises. Written and Oral Translations. Chapsal: Littérature Française. (2)

German.—Systematic Readings of various authors. Lessing, Herder, Goethe, Schiller. Dictation. Compositions in German. (2)

Zoology.—Lectures and Laboratory work. Tenney. (2)

Crystallography.—Lectures, with Practical Exercises in the determination of Crystals. (2)

Literature and History. (1)

Gymnasium. (2)

SECOND TERM.

History.—History of England: Hume. (3)

Philosophy.—Porter's Elements of Intellectual Science. (2) Political Economy. (1)

English.—Earle's Philology of the English Tongue. (2)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Gasc's Translator. Dictation. (2)

German.—Systematic Readings of various authors (continued). Compositions in German. (2)

Mineralogy.—Descriptive Mineralogy, with practical exercises in the determination of Minerals. (3)

Essays and Original Orations. (1)

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

International Law.—Lectures: Woolsey. (2)

History.—Decline and Fall of the Roman Empire. (3)

Philosophy.—Moral Philosophy. (2)

Astronomy.—Loomis' Treatise, with Lectures. (3)

French.—Grammar, Saintsbury: Specimens of French Literature. Corneille; Racine; Molière; Contemporary authors. Lectures on French Literature. Composition (2).

German.—Systematic Readings of various authors (continued). Lectures on German Literature. Compositions. (2)

[In both languages, Conversation Class *optional* throughout the year.]

Geology.—Lithology and Laboratory Practice. Formation of Strata. General Definitions of Geology. (2)

Essays and Original Orations. (1)

Gymnasium.

SECOND TERM.

Constitutional Law.—Lectures. (1)

History.—History of France. (2)

Philosophy.—History of Philosophy. (1) Philosophy of History. Lectures. (2)

Christian Evidences. (1)

French.—Systematic Readings. Composition. Lectures on French Literature. Lectures in French on Modern French authors. (2)

German.—Lectures on German Literature. Lectures in German on Modern German authors. Composition. (1)

Geology.—Historic, Dynamic and Economic Geology. (2)

Lectures on American and English Literature. (2)

Preparation of Thesis.

Gymnasium.

THE SCHOOL OF TECHNOLOGY.

This School includes five distinct courses:

I. The Course in Civil Engineering.
II. The Course in Mechanical Engineering.
III. The Course in Mining and Metallurgy.
IV. The Course in Electrical Engineering.
V. The Course in Chemistry.

These have the same curriculum of studies for the first term of the Freshman year. At the end of that time the student selects his course and follows its programme.

FRESHMAN CLASS.

FIRST TERM.

Mathematics.—Chauvenet's Geometry (completed). (4)

Chemistry.—Lectures. Fownes' Elementary Chemistry. (4)

German.—Brandt's Grammar. Lodeman's Manual of Exercises. Writing in German text. Translations into English. (3) Or *French.*—Chardenal. Keetel's Analytical Reader. (3)

Drawing.—Elementary Projections, Shading and Lettering. Descriptive Geometry. (2)

English.—Exercises and Declamations. (2)

Physiology and Health.—Lectures. (1)

Gymnasium. (2)

THE COURSE OF CIVIL ENGINEERING.

The special technical studies in this course may be grouped under the heads of Surveying, Applied Mechanics, Road and Railroad Construction, Bridge Design, and Hydraulic and Sanitary Engineering.

The work in Surveying extends over seven terms and embraces land surveying, leveling, topography, triangulation,

railroad reconnaissance and location, hydrography, and the elements of geodesy. A large equipment of transits, levels and other surveying tools, affords students the opportunity of becoming familiar with the instruments of different manufacturers. Much time is devoted to practice in the field and drafting room, each student being required to become proficient in the use of instruments, in taking field notes, and in map drawing. Particular attention is paid to the execution of a secondary triangulation of a high order of precision, and to the execution of topographical surveys and maps by the best modern methods.

The work in Applied Mechanics comprises the strength and elasticity of materials, the theory of the equilibrium of arches, roofs and bridges, that part of the mechanics of machinery which relates to locomotives and hoisting machines, and the theory of hydraulics and hydraulic motors. Here the theoretical principles are illustrated by examples and problems taken as far as possible from actual engineering practice.

The course in Construction familiarizes the student with the qualities of materials used in engineering structures, with methods of preservation and testing, with masonry and foundations, and with the building and maintenance of roads and railroads. Plans, drawings, and estimates of cost are prepared for the construction of a line of railroad, all details, such as drains, culverts, road crossings, etc., being worked out by each student.

The course in Bridge Design starts with the study of full specifications for a first-class iron highway or railroad bridge. Each student then makes the full computations, designs, working drawings, and bills of material for the particular span assigned him. The weight of the designed bridge is finally determined and compared with the dead load assumed for the calculations. The drawings are made and dimensioned in the same manner as in the drafting office of a bridge company. In connection with this course, visits of inspection to bridges in the vicinity are regularly made.

The work in Hydraulic and Sanitary Engineering em-

braces the study of systems of water supply, the collection, purification and distribution of water, the combined and the separate systems of sewerage, the methods for the disposal of sewage, and the best practice for the drainage and ventilation of houses. A hydraulic laboratory in the University Park affords opportunity for experiments on the actual measurement of water by means of weirs and orifices, and the testing of hydraulic motors.

Besides these special studies there is a course in astronomy which includes practical work in the observatory. The study of English, and of French or German, is continued, and instruction is given during four terms in crystallography, mineralogy, lithology and geology.

The student who completes all the studies of this course will receive the degree of Civil Engineer (C.E.)

FRESHMAN CLASS.

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

Surveying.—Theory of Chain and Compass Surveying. Computation of Areas. Elements of Leveling. (1)

German.—Grammar and Exercises (continued). Joyne's Otto's Reader. Translations. (3) Or *French.*—Grammar. Keetel's Reader. Translations. (3)

Drawing.—Projection Drawing and Descriptive Geometry. (3) Freehand Drawing. (1)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)

Physics.—Mechanics, Heat, and Electricity. Lectures (5)

German.—Grammar. Exercises. Translations. Readings. (2) Or *French*—Grammar. Chardenal's Exercises. Readings. Translations (2)

Drawing.—Isometric Drawing. Architectural Drawing. (2)

Surveying.—Use of the Compass, Level and Transit. Surveys and Maps of Farms. Colored Topography. (2)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics.—Differential and Integral Calculus: Olney. (4)

Physics.—Sound, Light and Meteorology. Lectures. (3)

German—Grammar. Exercises. Systematic Readings. Translations. Dictation. (2) Or *French.*—Grammar. Dictation. Chardenal's Exercises. O'Connor: Choix de Contes Contemporains. (2)

Mechanics.—Mathematical Theory of Motion. Science of Motion in General. Statics. Dynamics, and Statics of Fluids. Lectures on the Theory of Center of Gravity and Moment of Inertia. (4)

Surveying.—Profiles and Contour Maps. Hydrographic and City Surveying. Use of the Plane Table. Topographical Drawing. (3)

Essays and Declamations.

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Integral Calculus: Courtenay. (2)

German.—Systematic Readings. Translation. Dictation. Compositions. (2) Or *French.*—Translation. Readings. Contemporary Authors. Saintsbury: Specimens of French Literature. (2) Conversation Class in both languages optional.

Surveying.—Triangulation. Leveling. Topographical Surveying with Transit and Stadia. Topographical Map. (4)

Strength of Materials.—Elasticity and Strength of Wood, Stone, and Metals. Theory of Columns, Shafts and Beams. Reports on the Testing of Materials. (4)

Construction.—Materials of Construction. Masonry. Foundations. Construction of Roads and Pavements. (2)

Crystallography.—Lectures, with practical exercises in the determination of Crystals. (2)

Literature and History. (1)

Gymnasium. (2)

SECOND TERM.

German.—Systematic Readings. Compositions. Lectures on German Literature. (2) Or *French.*—Reading. Dictation. Compositions. Lectures on French Literature. (2)

Surveying.—Theory of Railroad Curves. Railroad Reconnaissance and Location. Survey of a Line, with Profile, Map and Estimate of cost. (4)

Roofs and Bridges.—Theory and Calculation of Strains in Roof and Bridge Trusses. (2)

Construction.—Stone cutting, with practical Drawings. (3) Construction and Maintenance of Railroads. Theory of Retaining Walls and Stone Arches. (2)

Mineralogy.—Descriptive Mineralogy, with practical exercises in the Determination of Minerals. (3)

Essays and Original Orations

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Astronomy.—Loomis' Treatise, with Lectures. (3)

Graphical Statics.—Analysis of Stresses in Roof Trusses, Bridge Trusses, and Arches. (2)

Bridges.—Suspension, Continuous and Cantilever Bridges. Design of an Iron Bridge, with Working Drawings. (6)

Surveying.—Use of Solar Transit and Sextant. (1)

Mechanics of Machinery.—Pile Drivers, Cranes, and Elevators. The mechanics of the Locomotive. (2)

Geology.—Lithology, with practical exercises in determining rocks. (2)

Gymnasium.

SECOND TERM.

Astronomy.—Doolittle's Practical Astronomy, with Observatory Work. (2)

Surveying.—Elements of Geodesy. The Figure of the Earth. Map Projections Elements of the Method of Least Squares. (2)

Hydraulics.—Hydrostatics. Efflux of water from orifices, and flow in pipes and rivers. Hydraulic motors. (2)

Hydraulic and Sanitary Engineering.—Collection, Purification and Distribution of Water. Systems of Water Supply. The Combined and the Separate System of Sewerage. Disposal of Sewage. House Drainage. Hydraulic Experiments. (5)

Geology.—Historic and dynamic. Le Conte. (2)

Lectures on English Literature. (2)

Christian Evidences.—Lectures. (1)

Preparation of Thesis

Gymnasium.

THE COURSE OF MECHANICAL ENGINEERING.

The object of this course is the study of the Science of Machines; the principal subjects taught are: the nature, equivalence and analysis of mechanisms, the mechanics or theory of the principal classes or types of machinery, Mechanical Technology and the principles and practice of Machine Design.

That the students may obtain the practical engineering data which they will most need when beginning their work

as mechanical engineers, they are required to pursue a course of Shop Instruction which does not necessarily involve manual labor and manipulation of tools, but is principally devoted to familiarizing them with those points in pattern-making, moulding, forging, fitting and finishing, which they need to know as designers of machinery. Particular attention is therefore directed to the forms and sizes of machine parts that can be readily constructed in the various workshops, to the time that it takes to perform, and the order of, the various operations, to the dimensions most needed by workmen and to the various devices for increasing the accuracy of the work, durability of the parts and convenience of manipulation. This involves acquaintance with the processes and machinery of the workshops, but it is the foreman's and superintendent's knowledge which is required rather than the manual dexterity and skill of the workman and tool hand. The acquirements peculiar to the latter are by no means despised, and students are encouraged to familiarize themselves therewith during leisure hours, but manual work in the shops forms no regular part of the course. On the contrary, the student enters the shop with hands and mind free to examine all the processes, operations and machinery, and is ready at the call of the teacher, to witness any operation of special interest. Provided with note-book, pencil, calipers and measuring rule, the student sketches the important parts of the various machine-tools, notes down the successive steps of each of the important shop-processes as illustrated by the pieces operated upon, and follows pieces of work through the shops from the pig or merchant form to the finished machine.

That the students may learn to observe carefully and be trained to think and observe for themselves in these matters, there is required of them a full description of the various processes, operations and tools involved in the production of each one of a series of properly graded examples of patterns, castings, forgings and finished pieces which are not being constructed in the shops at the time and the

blue prints for which have been given to them on entering the shops. The student's work is directed not only by these drawings and by the printed programme given him at the start, but also personally by a teacher, who accompanies him into the shops, gives necessary explanations, and tests the extent and accuracy of his knowledge by examining the sketches and notes and by frequent questioning. Finally the results of the observations and the sketches are embodied in a memoir.

During the course there are frequent visits of inspection to engineering works, both in and out of town, with special reference to such subjects as Machine Elements, Prime Movers, Machinery for lifting, handling and transporting, and Machinery for changing the form and size of materials. It is intended that each of these excursions shall have some definite purpose in view which must be fully reported upon by the students.

The instruction in Machine Design, during the second term of the Junior year, consists in determining rational and empirical formulas for proportioning such machine parts as come under the head of fastenings, bearings, rotating, sliding and twisting pieces, belt and toothed gearing, levers and connecting rods, also in comparing recent and approved forms of these same parts with respect to their advantages as regards fitness, ease of construction and durability, and in making full-sized working drawings of these parts; all the dimensions are determined by the students from the above mentioned-formulas, the data being given as nearly as possible as they would arise in practice. During the Senior year the students undertake the calculations, estimates and working drawings involved in the design of a simple but complete machine, each student being engaged upon a different machine. From the finished drawings of each machine, tracings are made and then blue prints taken for distribution among the other members of the class. The whole class also take up the design of a steam engine, every dimension being determined by the students, and complete working-drawings made. In the case of the

simple machines and of the steam engine, the general plan or arrangement will be given to the students in the form of rough sketches, photographs or wood-cuts This work will continue to the middle of the last term of the Senior year. From this time on the students are expected to make original designs for simple mechanisms, whose object has been fully explained. Throughout the course the work in the draughting room is carried on as nearly as possible like that of an engineering establishment, and special attention is paid to methods of expediting the work of calculation by means of simple formulas, tables and diagrams.

The graduate in this course will receive the degree of Mechanical Engineer (M.E.).

FRESHMAN CLASS.

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

German.—Grammar and Exercises (continued). Joynes' Otto's Reader. Translations. (3) Or *French.*—Grammar. Keetel's Reader. Translations. (3)

Drawing.—Projection Drawing and Descriptive Geometry. (3) Freehand Drawing. (2)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)

Physics.—Mechanics, Heat and Electricity. Lectures. (5)

Drawing.—Isometrical Drawing. Architectural Drawing. (2)

Visits of Inspection.—Shops of the vicinity. (2)

German.—Grammar. Exercises. Translations. Readings. (2) Or *French.*—Grammar. Chardenal's Exercises. Readings. Translations. (2)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics. – Differential and Integral Calculus: Olney. (4)

Physics.—Sound, Light and Meteorology. Lectures. (3)

German.—Grammar. Exercises. Systematic Readings. Translations. Dictation. (2) Or *French.*—Grammar. Dictation. Chardenal's Exercises. O'Connor: Choix de Contes Contemporains. (2)

Mechanics.—Mathematical Theory of Motion. Science of Motion in general. Statics. Dynamics and Statics of Fluids. Lectures on Theory of Center of Gravity and Moment of Inertia. (4)

Steam Engine.—Rigg's Practical Treatise. (3)

Essays and Declamations. (1)

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Integral Calculus: Courtenay. (2)

German.—Systematic Readings. Translation. Dictation. Compositions. (2) Or *French.*—Translations. Readings. Contemporary authors. Saintsbury: Specimens of French Literature. (2) Conversation Class in both languages optional.

Mechanical Technology.—Shop instruction. Examination of the processes and appliances involved in pattern making, moulding, forging, fitting and finishing, with sketches and reports. (7)

Boilers.—Wilson. Strength, construction and wear and tear of boilers. (1)

Strength of Materials.—Elasticity and strength of wood, stone and metals. Theory of beams, shafts and columns. Reports on experimental tests. (4)

Literature and History. (1)

Gymnasium. (2)

SECOND TERM.

German.—Systematic Readings. Compositions. Lectures on German Literature. (2) Or *French.*—Reading. Dictation. Compositions. Lectures on French Literature. Conversation Class in both languages optional. (2)

Kinematics of Machinery. Reuleaux. Nature and Equivalence of Mechanisms. (3)

Machine Design.—Proportioning of such machine parts as come under the head of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers and connecting rods. (5)

Metallurgy.—Metallurgical Processes. Furnaces. Refractory Building Materials. Combustion. Natural and Artificial Fuels. Metallurgy of Iron. (4)

Machinery of Transmission.—Weisbach-Herrmann. (2)

Essays and Original Orations.

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Thermodynamics.—General principles; application to Steam Engines and Air Compressors. (3)

Graphical Statics.—Graphical Analysis of Roof Trusses and Girders. (2)

Machine Design.—Calculations and working-drawings for a High-speed Steam Engine. (4)

Kinematics.—Diagrams of the changes of position, speed and acceleration in mechanisms. Link and valve motions. Quick return motions. Parallel motions. Laying out of Cams. (3)

Mechanics of Machinery.—Weisbach-Herrmann. Hoisting Machinery, Accumulators, Cranes and Locomotives. (4)

Gymnasium.

SECOND TERM.

Mechanics of Machinery.—Weisbach-Herrmann. Pumps, Pumping Engines, Blowing Engines, Compressors and Fans. (4)

Machine Design.—Calculations and working-drawings for the following machines: Drilling, Shaping, Milling, Shearing and Punching Machines, Hoists, Pumps and Stone Crushers. Original Designs. (5)

Hydraulics.—Hydrostatics. Flow of water in pipes and channels; hydraulic motors. (2)

Measurement of Power.—Indicating of Steam Engines; determination of evaporative efficiency of boilers; dynamometer experiments. (1)

Lectures on American and English Literature. (2)

Christian Evidences.—Lectures. (1)

Preparation of Thesis.

Gymnasium.

THE COURSE IN MINING AND METALLURGY.

This course aims to fit the student for practical work in either of the branches of Mining, Metallurgy, Metallurgical Chemistry, or Geology. On account of the great number and scope of the studies necessary to the completion of this course, it is five years in length. At the completion of the fourth year the student will have completed a course similar to that leading to the Scientific degree in

other institutions and will receive the degree of Bachelor of Science in Mining and Metallurgy (B.S).

The graduate in this course will receive the degree of Engineer of Mines (E.M.), which includes that of Metallurgist.

CHEMISTRY.—The course in Theoretical and Applied Chemistry extends over three years and includes the methods of wet and dry Assaying and Blowpipe analysis combined with the working of Stoichiometric problems and the Study of Chemical Philosophy. The practical work is that required for a Metallurgical Chemist or Assayer.

With moderate care the expenses in this department need not exceed $120.

METALLURGY.—This course extends over one year and, after treating of the principles of the subject, enters minutely into the processes for the extraction and separation of metals from ores, with details of the necessary plants required and costs of extraction. A special laboratory attached to this department affords practical work in metallurgical problems.

GEOLOGY.—Three terms are devoted to Crystallography, Mineralogy, and Macroscopic Lithology. In each study, after a grounding of the theory of the subject, there is an extended course in practical determination of the most important species. There are from three to four hundred specimens to illustrate the first study and from three to five thousand hand specimens for each of the two latter. A year is then given to dynamic, historic and economic Geology, and this is supplemented by field work and the construction of maps and sections.

ASTRONOMY.—After studying the theory of the subject, two thirds of the year are devoted to practical work in the Observatory.

APPLIED MECHANICS.—This embraces Hydraulics, a study of the Steam Engine and the mechanics of machines employed in Mining and Metallurgy.

SURVEYING.—A course extending over five terms offers practice in land, mine, and geological surveying, leveling, topography, triangulation, and railroad reconnaissance and location. It also includes practical work in drawing and map construction.

MINING.—This course covers the theory and practice of locating and winning deposits with a full discussion of and practice in the engineering problems occurring in Mining, such as haulage, pumping, ventilation and hygiene, ore-dressing, and mining Law. A series of projects supplement the problems and give practical studies in Mining and Metallurgy.

The location of the University in the vicinity of the iron works of the Lehigh Valley and especially of the extensive establishment of the Bethlehem Iron Company, affords unusual facilities for the practical study of iron metallurgy. The processes for the manufacture of spelter and oxide of zinc may be studied at the Bethlehem Zinc Works. The facilities for the practical study of mining and economic geology are not excelled by those of any other Institution in the country. The zinc mines at Friedensville and the brown hematite and slate deposits of the Lehigh Valley are in the immediate vicinity, while within easy reach by rail are the anthracite coal fields of Pennsylvania, the iron and zinc mines of New Jersey, and the celebrated iron mines at Cornwall, Pa.

FRESHMAN CLASS.

SECOND TERM.

Mathematics.—Olney's University Algebra, Pt. III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic tables. (2)

German.—Grammar and Exercises (continued). Joyne's Otto's Reader. Translations. (3) Or *French.*—Grammar. Keetel's Reader. Translations. (3)

Drawing.—Projection Drawing and Descriptive Geometry. (3) Freehand Drawing. (1)

Surveying.—Theory of Chain and Compass Surveying. Computation of Areas and Leveling. (1)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics. — Analytical Geometry: Olney's General Geometry. (4)

Physics.—Mechanics, Heat and Electricity. Lectures. (5)

German.—Grammar. Exercises. Translations. Reading. (2) Or *French.*—Grammar. Chardenal's Exercises. Readings. Translations. (2)

Drawing. — Isometric Drawing. Architectural Drawing. (2)

Surveying.—Use of the Level and Transit. Surveys and Maps of Farms. Colored Topography. (2)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics. — Differential and Integral Calculus: Olney. (4)

Mechanics.—Mathematical Theory of Motion. Science of Motion in general. Statics. Dynamics and Statics of Fluids. Lectures on Theory of Center of Gravity and Moment of Inertia. (4)

Chemistry.—Lectures and Laboratory Practice. Douglass and Prescott's Qualitative Analysis. (4)

Stoichiometry. (2)

German.—Grammar. Exercises. Systematic Readings. Translations. Dictations. (2) Or *French.* — Grammar. Dictation. Chardenal's Exercises. O'Connor: Choix de Contes Contemperains. (2)

Essays and Declamations.

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Integral Calculus: Courtenay. (2)

Strength of Materials.—Elasticity and strength of wood, stone and metals. Theory of beams, columns and shafts. (4)

Crystallography.—Lectures, with Practical Exercises in the determination of Crystals. (2)

Surveying.—Triangulation. Leveling. Topographical Surveys with Transit and Stadia. Topographical Maps. (4)

Chemical Philosophy.—Cooke. (3)

German.—Systematic Readings. Translation. Dictation. Compositions. (2) Or *French.*—Translation. Readings. Comtemporary Authors. Saintsbury: Specimens of French Literature. (2) Conversation Class in both languages optional.

Literature and History.

Gymnasium. (2)

SECOND TERM.

Mineralogy.—Descriptive Mineralogy, with Practical Exercises in the Determination of Minerals: E. S. Dana. (3)

Blow-Pipe Analysis.—Lectures, with Practice. Plattner, Brush, or Nason and Chandler. (1)

Chemistry.—Fresenius' Quantitative Analysis. (3) The following analyses are executed by the student:

1. Iron Wire (Fe)
2. Copper Ore (Cu)
3. Silver Coin (Au, Ag, Pb, Cu)
4. Zinc Ore (Zn) By both Gravimetric and Volumetric Methods.
5. Bronze (Cu, Sn, Zn, Pb)
6. Spiegeleisen (Mn)
7. Lead Ore (PbS)
8. Ilmenite (TiO_2)
9. Iron Ore (Complete Analysis)

Steam Engine.—Rigg's Practical Treatise. (3)

Surveying.—Theory of Railroad curves. Railroad Reconnaissance and Location. Survey of a Line, with Profile, Map and Estimate of cost. (4)

German.—Systematic Readings. Compositions. Lectures on German Literature. (2) Or *French.*—Reading. Dictation. Compositions. Lectures on French Literature. (2) Conversation Class in both languages.

Essays and Original Orations.

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Thermodynamics.—General principles; application to Steam Engines and Air Compressors. (3)

Geology.—General Geological Definitions and Principles. Dynamic Geology. (2)

Lithology.—Theory, with practical exercises in determining rocks. (3)

Chemistry.—Quantitative Analysis: Laboratory Work: Fresenius. (5) The following analyses are executed by the student:

10. Limestone (Complete Analysis)
11. Coal (Volatile Matter, Fixed Carbon, Ash, H_2O, S, P)
12. Slag (Complete Analysis)
13. Pig Iron (Complete Analysis)
14. Carbon in Steel (Volumetric)
15. Nickel Ore (Ni, Co)
16. Gas Analysis.

Assaying.—Including the Assay by the dry methods of Gold, Silver, Antimony, Mercury, Lead, Iron and Tin ores. Laboratory Work. Ricketts. (3)

SECOND TERM.

Metallurgy.—Metallurgical Processes. Furnaces. Refractory Building Materials. Combustion. Natural and Artificial Fuels. Metallurgy of Iron. (4)

Mining.—Modes of Occurrences of the Useful Minerals. Searching for Mineral deposits. Examination of Mining Properties. Boring. Mining Tools, Machines and Processes. Timbering and Masonry. Callon. André. Lectures. (3)

Geology.—Historic and Economic Geology. Lectures. Le Conte. Dana. (4)

Blow-pipe Analysis.—Practice. (1)

Hydraulics.—Hydrostatics. Flow of water in pipes and channels. Hydraulic motors. (2)

Surveying.—Mine Survey. Theory and Practice, with construction of Mine Maps. Tunneling and Shaft location. (2)

Gymnasium.

POST-SENIOR CLASS.

FIRST TERM.

Metallurgy.—Of Copper, Lead, Silver, Gold, Platinum, Mercury, Tin, Zinc, Nickel, Cobalt, Arsenic, Antimony and Bismuth. (5)

Mining.—Methods of Working. Underground Transportation. Hoisting, Drainage and Pumping. Ventilation and Lighting. Hygiene of Mines. (4)

* *Mechanics of Machinery.*—Weisbach-Herrmann. Hoisting Machinery, Accumulators, Cranes. (2)

Astronomy.—Descriptive Astronomy: Loomis. (3)

* *Surveying.*—Geological Survey: Mapping and cross-sectioning. (2)

SECOND TERM.

Mining.—Mechanical Preparation of Ores. Coal Washing. (2)

Mechanics of Machinery.—Pumps, Pumping-Engines, Blowing-Engines, Compressors and Fans. (4)

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* The Surveying is completed in the first half of the term by taking four exercises per week. The Mechanics of Machinery is then begun.

Astronomy.—Doolittle's Practical Astronomy, with Observatory Work. (2)
Drawing.—Mining Plant. Systems of Timbering. (3)
Projects.—In Mining, Geology and Metallurgy. (2)
Lectures on American and English Literature. (2)
Christian Evidences.—Lectures. (1)
Preparation of Thesis.

THE COURSE IN ELECTRICAL ENGINEERING AND PHYSICS.

This course will replace in September 1888, the present one year's Advanced Course in Electricity. The Freshman and Sophomore Classes only will then be formed, as the necessary equipments and facilities for the instruction of the higher classes have not yet been completed.

The degree of Electrical Engineer (E.E.) will be given to the graduates of this course.

In the arrangement of the details of this new course, the object has been to provide for those, who seek to fit themselves as Electrical Engineers, a preliminary training as complete and broad as that given to the members of the other schools. The requirements for admission, the mathematical and English studies, the modern languages and other outside branches are the same as those in the other technical courses. To these have been added such portions of the Mechanical Engineering Course, with which this course is most closely allied, as are necessary to give the student a general, but sufficiently accurate knowledge of machinery.

This preparation joined to the unusually full development of Physics—and especially of Electricity—will, it is thought, make a course sufficiently comprehensive and thorough for the proper training of candidates for this degree. The great success attending the large majority of the young men who have taken the one year's Course in Electricity, in their subsequent electrical work, warrants

the belief that this broader and more extended course will attain its object.

The main feature of this new course is the prominence given to the subject of Physics. This extends through three years and while Electricity is specially developed, the other branches, Elementary Mechanics, Heat and Light are fully provided for. The opportunity is thus given to any one, who wishes to acquire a more extensive knowledge of Physics than the University curriculum has heretofore offered. The student is well drilled in the theory by means of lectures and recitations, which carefully cover the whole subject and he is required to go over the ground himself in the best of all schools—the working laboratory. Enough of work on each topic is given him to render him familiar with his subject. Much prominence is given to work that brings out the resources of the student himself, such as the construction of instruments and original investigation. He is encouraged to this and a regular portion of his time is set apart for this object.

FRESHMAN CLASS.

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

Chemistry.—Lectures and Laboratory Practice. Douglass and Prescott's Qualitative Analysis. (2)

German.—Grammar and Exercises (continued). Joynes' Otto's Reader. Translations. (3) Or *French.*—Grammar. Keetel's Reader. Translations. (3)

Drawing.—Projection Drawing. Descriptive Geometry. Freehand Drawing. (3)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics. — Analytical Geometry: Olney's General Geometry. (4)

Mechanics, Sound and Heat.—(Theory, lectures and recitations.) (3)

Mechanics.—(Physical Laboratory). Exact Measurements. Density. Elasticity. Tenacity. Hydrostatics. Specific Gravity. Atmospheric Pressure (with barometric leveling.) Gravitation. Moments of Inertia.

Sound.—Determination of velocities and wave lengths. Measurements of vibrations. Verifications of laws of vibrations of sounding bodies.

Heat.—Construction of Instruments. Thermometry. Expansion. Conduction. Radiation. (4)

Drawing.—Isometrical Drawing. Architectural Drawing. (2)

German.—Grammar. Exercises. Translations. Readings. (2) Or *French*—Grammar. Chardenal's Exercises. Readings. Translations. (2)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics. — Differential and Integral Calculus: Olney. (4)

Heat.—Continued. (Physical Laboratory.) Fusion and Vaporization. Calorimetry. Hygrometry. Elementary Thermodynamics. (3)

German.—Grammar. Exercises. Systematic Readings. Translations. Dictation. (2) Or *French.*—Grammar. Dictation. Chardenal's Exercises. O'Connor: Choix de Contes Contemporains. (2)

Mechanics.—Mathematical Theory of Motion. Science of Motion in general. Statics. Dynamics and Statics of

Fluids. Lectures on Theory of Center of Gravity and Moment of Inertia. (4)

Steam Engine.—Rigg's Practical Treatise. (3)

Essays and Declamations.

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Integral Calculus: Courtenay. (2)

German.—Systematic Readings Translation. Dictation. Compositions. (2) Or *French.*—Translations. Readings. Contemporaneous authors. Saintsbury: Specimens of French Literature. (2) Conversation Class in both languages optional.

Light and Magnetism.—(Theory; text-books and lectures.) (3)

Light.—(Physical Laboratory). Investigation of general Principles and Laws. Determination of Focal Lengths and Indices of Refraction, Testing and Adjustment of Optical Instruments. Spectroscopic Analysis. Photometry. Polarization. Diffraction.

Magnetism.—Fundamental Experiments. Verification of Laws of Magnets. Study and Mapping of Lines of Force. Determination of Moments of Magnets; and of horizontal component and whole intensity of Earth's Magnetism in absolute units. Distribution of Magnetism. (3)

Meteorology.—Text-book and practice. Observations for several months as taken in the U. S. Signal Service stations; with all the usual corrections and reductions; construction of charts; mapping curves; reports etc. (1)

Strength of Materials.—Elasticity and strength of wood, stone and metals. Theory of beams, columns and shafts. (4)

Boilers.—Wilson. Strength, construction and wear and tear of boilers. (1)

English.—Exercises and Declamations.

Gymnasium. (2)

SECOND TERM.

Electricity.—(Theory ; text-books and lectures. (3)

Static Electricity.—(Physical Laboratory). Investigation of Principles. Quantitative Laws. Measurements of Potential, Capacity, etc. Induction. Condensation. Analysis of Machines.

Voltaic Electricity. -Management and care of a large variety of batteries. Construction of Instruments. Determination of Constants. Electro-Magnetism. Induction. Electro-Dynamics. Electrical Measurements of Potential, Resistance and Current Strength. Electrolysis. Electroplating. Electrotyping. Thermo-Electricity. Secondary Batteries. Relation of Electrical Currents to Heat and Mechanical Work. (5)

German.—Systematic Readings. Compositions. Lectures on German Literature : Deutsche Literatur. (2) Or *French.* —Reading. Dictation. Compositions. Lectures on French Literature. Conversation Class in both languages, optional. (2)

Machine Designs.—Proportioning of such machine parts as come under the head of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers and connecting rods. (5)

Literature and History.- Lectures. (1)

Essays and Original Orations.

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Dynamic Machines.—Theory, text-book and lectures. (2) (Physical Laboratory). Practical running and care of dynamos and motors. Measurements of magnetic field, potential, resistance and heating. Visits to manufactories and working systems. (2)

Electric Lighting.—Lectures. (2) (Physical Laboratory). Study of different systems. Calculations and arrangement

of plant. Wiring. Insulation. Photometric tests of different arc and incandescent lamps. Determination of heat units given off by various incandescent lamps; their resistance (hot and cold). Energy consumed in lamps and conductors. Spectroscopic tests of purity of carbons. (3).

Machine Design.—Calculations for a High Speed Steam Engine. (2)

Astronomy.—Loomis' Treatise, with Lectures. (3)

Graphical Statics of Mechanism.—Herrmann Smith. (2)

Scientific Readings.

Gymnasium.

SECOND TERM.

Telegraphs and Telephone.—Investigation of different systems. Arrangement of lines and stations. Test of lines for conductivity, insulation, location of faults etc. (2)

Application of Electricity to Railways.—Theory of the two systems, with inspection of electric railways. (1)

Measurement of Power.—Indicating of Steam Engines; dynamometer experiments. (1)

Dynamic Machines.—(Physical Laboratory). Tests of Efficiency in Generators and Motors etc. (1)

Physics.—Original Investigation. (5)

English Literature.—Lectures on English and American Literature. (2)

Christian Evidences. (1)

Preparation of Thesis.—(With laboratory work).

Gymnasium.

THE COURSE IN CHEMISTRY.

This course of study is designed to prepare students for the profession of the Chemist, in connection with metallurgical establishments, sugar refineries, gas works, superphosphate works, electrical machinery manufactories, mining companies, etc., and the general consulting and

analytical work of the Professional Chemist. It is also well adapted for the preparation of teachers of chemistry and as a preliminary course to the study of medicine. It is eminently practical, the student's time being largely occupied by practical work in the large, well equipped and well ventilated chemical laboratories, which were completed in 1885 and constitute the best contructed building for this purpose in this country. The museum of Chemistry contains large collections of specimens, illustrating theoretical and applied chemistry, for illustrating the lectures on these subjects.

THEORETICAL CHEMISTRY.—Instruction in this subject begins with lectures four times a week, in the first term of the Freshman year; these lectures are fully illustrated by experiments, colored diagrams, working drawings and lantern pictures and specimens from the museum. These lectures include a general introduction to Theoretical Chemistry and a description of the non-metallic and metallic elements and their compounds, the general subject of inorganic chemistry. The students are required to take notes of the lectures, and to pass a written examination at the end of the term.

In the second term of this year Stoichiometry and chemical problems and reactions are taught by recitations twice each week.

The study of Theoretical Chemistry is continued throughout the Sophomore year, by recitations three times a week from Cooke's Chemical Philosophy and is concluded in the first term of Junior, by a course of lectures and recitations on Theoretical Organic Chemistry, four times a week. These lectures are illustrated by experiments and by specimens from the museum of Chemistry.

Written examinations are held at the close of each of the above courses.

ANALYTICAL CHEMISTRY. — Qualitative Analysis is taught in the second term of the Freshman year, by lectures, recitations and practical work in the Qualitatlve Labora-

tory, twelve hours of practical work per week being required. This laboratory is a large, well ventilated and well lighted room, and supplied with convenient working tables, vacuum filtration, hoods for noxious vapors, steam baths, gas and washing appliances and a commodious room for hydrosulphuric acid. Distilled water is delivered by faucet in this room and the other large laboratories. At the close of the term a practical examination is held in this subject.

After completing this course, Quantitative Analysis is taken up throughout the Sophomore and the first term of the Junior years. This subject is taught by lectures, recitations and practical work in the Quantitative Laboratory, which is equipped similarly to the Qualitative Laboratory, but is supplied in addition with apparatus for drying precipitates and residues, rooms for the chemical balances, for combustions, and for a reference library.

Twelve hours per week are required during the first term of the Sophomore year and fifteen hours during the second term of that year and the first term of the Junior year.

The course consists in Gravimetric and Volumetric Analyses, as applied to the substances given in the lists farther on, accuracy being required in the determination of each constituent.

At the close of each term, written and oral examinations are held upon the theory and practice of Quantitative Analysis.

Gas · Analysis is taught by lectures and laboratory practice in the Gas Laboratory. This laboratory is supplied with full and complete apparatus for Gas Analysis, according to Bunsen's processes, as well as apparatus for some of the more rapid methods. Mixtures of gases are required to be analyzed by the students, within certain limits of error, and a written examination, on the theory and practice, is held at the close of the course.

Assaying.—The Assaying of ores by furnace assay, together with gold and silver bullion analysis, by processes

practiced in the United States Mint, is taught by lectures and practical work in the first term of the Junior year, nine hours of practical work per week being required. The course includes the assaying of ores of lead, tin, antimony, gold, silver and iron, coal, and gold and silver bullion.

The Assaying Laboratory is supplied with large working tables, twenty-nine crucible and two iron furnaces, and eight muffle furnaces, with adjoining rooms for balances, and gold and silver bullion analysis.

A certain accuracy of results and a written examination as regards the theory and practice are required.

ORGANIC CHEMISTRY.—The practical work in this subject is performed in the second term of the Junior and first term of the Senior years, fifteen hours during the former and twelve hours during the latter term being required, with conferences and recitations each week. The laboratory for this work is equipped similarly to the Quantitative Laboratory, in addition being supplied with steam heat, cold water and air blast upon the working tables, and a full supply of apparatus for the various determinations and experiments, including combustion furnaces, furnaces for heating sealed tubes, mercury pump, Hoffman's, Dumas' and Meyers' apparatus for vapor densities, nitrometers, chemical balances, etc.

The course consists of determinations of specific gravities, melting points, boiling points, vapor densities, chlorine, bromine, iodine and sulphur of organic substances.

Combustion analysis, nitrogen determination, fractional distillation, and the preparation of several pure organic compounds and their analysis are included.

INDUSTRIAL CHEMISTRY. — A course of lectures is delivered upon this subject in the second term of the Senior year, illustrated by experiments, diagrams, lantern pictures and specimens from the museum of Chemistry. The working laboratory for this subject contains an apparatus for making illuminating gas, an alcohol still, worm and doubler and a complete working model of a sugar refinery, includ-

ing filters, vacuum pan and centrifugal. In connection with this laboratory is a room containing a photometer and apparatus for determining the sulphur, ammonia and specific gravity of illuminating gas; also a laboratory for the testing of alcoholic liquors, sugar, molasses, bone black, soap, petroleum, paints, dyes, superphosphates and other commercial products, with the necessary technical apparatus. The students make practical experiments in this direction, and, with an instructor, visit various industrial establishments in this neighborhood and in and around New York City.

Toxicology.— A course of lectures on this subject is given in the first term of the Junior year, illustrated by experiments and by the large collection of specimens of poisons from the museum of chemistry. This is supplemented by a short course of laboratory work on some of the common poisons.

Sanitary Chemistry. — During the second term of the Senior year, attention is given to the qualitative and quantitative examination of air, water, food, disinfectants, and other subjects connected with this branch of the science. Special apparatus is provided for this work, as recommended by the best authorities on the subject.

Photographic Chemistry. — Well equipped Photographic Laboratory and dark rooms are provided, in which the students of the chemical course receive practical instruction.

Physiological Chemistry. — The examination of urine, blood, etc., receives a proper amount of attention.

The course also includes instruction in physics, mineralogy, blowpipe analysis, metallurgy and geology, which are of great value to the chemist.

In the last term of the Senior year, the student is required to prepare a Thesis on some subject, selected by the Professor of Chemistry, involving practical work in the laboratory in addition to the literary labor, each graduate

thus making a contribution to the progress of the science, as a preliminary to the reception of his degree.

The graduate of this course receiving the degree of Analytical Chemist. (A.C.)

Students, not candidates for a degree, are admitted for special courses in chemistry, of which they receive certificates.

The Laboratories are under the immediate charge of the Professor and Instructors of Chemistry and are open to the students from 8 o'clock, A.M., to 6 o'clock, P. M., including Saturdays. Students are at liberty to work in the Laboratories, beyond the required hours, as their time may permit. Students are charged for materials and apparatus consumed; with moderate care this expense need not exceed $50 per year.

FRESHMAN CLASS.

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

Chemistry.—Lectures and Laboratory Practice. Douglass and Prescott's Qualitative Analysis. (4)

German.—Grammar and Exercises (continued). Joynes' Otto's Reader. Translations. (3) Or *French.*—Grammar. Keetel's Reader. Translations. (3)

Stoichiometry. (2)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Chemical Philosophy.—Cooke. (3)

Quantitative Analysis.—Fresenius' Quantitative Analysis. (4)

The following analyses are executed by the student :

1. Iron Wire (Fe)
2. Potassium Dichromate (Cr_2O_3)
3. Barium Chloride (Ba, Cl, H_2O)
4. Magnesium Sulphate (MgO, SO_3, H_2O)
5. Disodium Hydrogen Phosphate (P_2O_5)
6. Rochelle Salt (K_2O, Na_2O)
7. Volumetric Determination of Chlorine.
8. Acidimetry (HCl, H_2SO_4, HNO_3, $HC_2H_3O_2$)
9. Alkalimetry (KOH, NaOH, NH_4OH, Soda Ash, Pearl Ash)
10. Chlorimetry (Bleaching Powders)

Quantitative Analysis—Conference. (1)

Physics.—Mechanics, Heat and Electricity. Lectures. (5)

German.—Grammar. Exercises. Translations. Reading. (2) Or *French.*—Grammar. Chardenal's Exercises. Readings. Translations. (2)

English.—Exercises and Declamations. (1)

Gymnasium. (2).

SECOND TERM.

Physics.—Sound, Light and Meteorology. Lectures. (3)

German.—Grammar. Exercises. Systematic Readings. Translations. Dictation. (2) Or *French.* — Grammar. Dictation. Chardenal's Exercises. O'Connor: Choix de Contes Contemporains. (2)

Quantitative Analysis.—Fresenius' Quantitative Analysis. (5)

The following analyses are executed by the student :

11. Copper Ore (Cu)
12. Zinc Ore (Zn). By both Gravimetric and Volumetric Methods.
13. Lead Ore (Pb, S)
14. Silver Coin (Au, Pb, Ag, Cu)
15. Spiegeleisen (Mn)
16. Copper Alloys. (Complete Analysis.)

17. Ilmenite (TiO_2)
18. Iron Ore (Complete Analysis)
19. Limestone (Complete Analysis)
20. Coal (Volatile Matter, Fixed Carbon, Ash, H_2O, S, P)
21. Slag (Complete Analysis)

Quantitative Analysis.—Conference. (1)

Blow-Pipe Analysis.—Lectures, with Practice. Plattner, Brush, or Nason and Chandler. (1)

Chemical Philosophy. (3)

Essays and Declamations. (1)

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Toxicology.—Lectures. (2)

Quantitative Analysis.—Fresenius' Quantitative Analysis. (5)

The following analyses are executed by the student:

22. Guano (NH_3, P_2O_5, H_2O)
23. Clay (Complete Analysis)
24. Manganese Ore (MnO_2)
25. Mineral Water (Complete Analysis)
26. Pig Iron (Complete Analysis)
27. Nickel Ore (Ni, Co)
28. Carbon in Steel (Volumetric)
29. Gas Analysis.

Quantitative Analysis.—Conference. (1)

Organic Chemistry.—Lectures and Recitations. (4)

Crystallography.—Lectures, with Practical Exercises in the Determination of Crystals. (2)

German.—Systematic Readings. Translation. Dictation. Compositions. (2) Or *French.*—Translation. Readings. Contemporary authors. Saintsbury: Specimens of French Literature. (2) Conversation Class in both languages optional.

Gymnasium. (2)

SECOND TERM.

Organic Chemistry.—Laboratory. (5)

Organic Chemistry.—Conference. (1)

Metallurgy.—Metallurgical Processes. Furnaces. Refractory Building Materials. Combustion. Natural and Artificial Fuels. Metallurgy of Iron. (4)

German.—Systematic Readings. Compositions in German. Lectures on German Literature. (2) Or *French.*—Systematic Readings. Compositions. Lectures on French Literature. Conversation Class in both languages optional. (2)

Mineralogy.—Descriptive Mineralogy, with Practical Exercises in the Determination of Minerals. E. S. Dana. (3)

Essays and Original Orations. (1)

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Metallurgy.—Of Copper, Lead, Silver, Gold, Platinum, Mercury, Tin, Zinc, Nickel, Cobalt, Arsenic, Antimony and Bismuth. (5)

Assaying.—Including the Assay by the dry methods of Gold, Silver, Antimony, Lead, Iron and Tin ores, Coal, Gold and Silver Bullion and rich Lead. Ricketts. (3)

Organic Chemistry.—Laboratory. (4)

Organic Chemistry.—Conference. (1)

Geology.—Lithology, with Practical Exercises in determining rocks. (3)

Gymnasium.

SECOND TERM.

Industrial Chemistry.—Lectures and Laboratory. (4)

Agricultural Chemistry.—Lectures. (1)

Sanitary Chemistry.—Laboratory. (1)

Geology.—Historic and Dynamic Geology. Lectures. Le Conte. (2)

Christian Evidences.—Lectures. 1)
Lectures on American and English Literature. (2)
Preparation of Thesis. (5)
Gymnasium.

THE COURSE IN ELECTRICITY.

[NOTICE.—This course will be continued during the present University year of 1887–88; after which it will be replaced by the new four years' course in Physics and Electrical Engineering.]

This course was established to answer the growing demand for more extensive and thorough knowledge of the subject of Electricity and its application to Machines, Telegraphy, Electric Lighting, etc.

Instead of an extended department of Electrical Engineering including full courses of Mathematics, Mechanics, Chemistry, etc., and extending over four years, it was thought best to offer for the present a course, occupying not more than one year and presenting very fully the purely electrical portion of an Electrical Engineering course, with only such outside branches as are absolutely necessary for the proper understanding of this single subject.

FIRST TERM.

Magnetism and Electricity.—Text-book (S. P. Thompson) and Lectures. Electrical Arithmetic (Day's). (5)

Mechanics.—(Laboratory work.) Precise Measurements with beam-compass, spherometer, cathetometer, micrometers, etc. Testing balances. Specific gravities of solids, liquids and gases by all known methods, with balances, hydrometers, comparison of densities and cathetometer, etc.; with corrections for temperature and buoyancy of air, etc. Laws of gravity, with determinations by Atwood's machine, pendulum, etc. Elasticity; Young's modulus by stretching, flexure and torsions, tenacity of wires, superficial tension by capillary tubes of different liquids. Work with

mercurial and aneroid barometers, with all corrections and reductions, to freezing point, sea level, etc.; measurement of heights and leveling roads. (3)

Magnetism and Static Electricity. — (Laboratory work.) Making and testing permanent magnets. Verification of laws by Coulomb's torsion balance. Measurements of portative force, strength of pole, effects of heating, percussion, etc. Study of the distribution of magnetism and drawing magnetic curves. Investigation of local attraction, variation of magnetic needle and intensity of the earth's magnetism.

Construction of electroscopes, condensers. Determination of electrical character of many substances. Verification of laws of electrical attraction and repulsion. Measurements of conductivity, electric density and capacity. Study of laws of Static induction, specific inductive capacity, etc., and of condensers. Analysis of machines, electrophorus, plate glass machines, Holtz's, etc. (5)

Meteorology.—Text-book (Loomis) and practice. Observations for one month as taken in the U. S. Signal Service stations; with all the usual corrections and reductions; construction of charts; mapping curves, etc. (5)

Drawing. — Elementary Projections. Freehand Drawing. (3)

SECOND TERM.

Dynamic Machinery.—Text-book (S. P. Thompson) and lectures.

Electric Lighting.—Text-book (Du Moncel) and lectures.

Telegraph.—Lectures. (5)

Sound, Heat and Light.—(Laboratory work.) Determination of number of vibrations of notes with Siren, comparison of pitch of tuning forks. Determination of velocity of sound in air. Verification of laws of vibrations of strings. Determination of absolute pitch of notes by the monochord and of wave lengths of notes by sensitive flames. Making and testing thermometers; determinations of freezing and boiling points of different substances; of coefficients of

expansion of solids, liquids and gases; of specific heat of bodies by the known methods and of latent heat of fusion and vaporization. Humidity by various methods. Verification of the laws of light. Photometry; testing intensities of lights with Bunsen's, Rumford's, Foucault's and daylight photometers. Tests of absorptive power of different substances. Index of Refraction of unknown substances by various methods. Measurements of focal lengths of lenses and mirrors. Construction of optical instruments, finding magnifying power, etc. Spectroscopic work; mapping Frauenhofer lines; identification of unknown substances in solution; absorption spectra (solids and liquids); comparison of spectra; mapping of spectra. Interference. Diffraction spectra. Construction of polariscopes; laws of polarization by reflection and double refraction. Study of uniaxial and biaxial crystals. (3)

Dynamic Electricity.—(Laboratory work.) Setting up, use and care of all batteries in common use, Grove's, Daniel's, LeClanchè's, Bichromate, Bunsen's, Smee's, Gravity, etc.; Secondary batteries, Plantè's, Faure's. Construction of electro-magnets; tests for portative force and strength of pole under varying conditions of current strength, size of wire, number of coils, length and diameter of cores, etc. Laws of currents. Electro-Dynamics. Testing thermo-electric batteries, Noë's and Clamond's. Electrolysis, electrotyping and electroplating. Making induction coils; testing different orders of induced currents and extra currents. Similar study of magnetic induction. Analyses and tests of electro-magnetic and dynamic machines. Diamagnetism. (5)

Electrical Measurements.—(Laboratory work.) Practical construction of instruments; sine, tangent and differential galvanometers, ammeters, voltameters, resistance coils, commutators, etc. Verification of Ohm's laws under varying conditions of electromotive force and external and internal resistance. Measurement of resistance of solid and liquid conductors in single and divided circuits; and of effects of change in temperature: of internal resistance,

electromotive force and current strength of voltaic batteries. Measurements of quantitative laws of electrolysis, comparisons of voltameters and galvanometers. Testing electric lights, measurements of potential of incandescent lamps; their resistance, hot and cold and amount of heat units given off. Photometric measurements of incandescent lamps; Swan's, Lane-Fox's, Maxim's, Edison's, etc.; and of arc lamps, Weston's, Thompson-Houston's, etc. Spectroscopic study of all these lights and mapping their spectra.

Photographing the lines of force of the field magnets of various types of dynamos. Measurements of current strength, difference of potential and resistance of dynamos. Study of different plants and systems of dynamos by visits to manufactories and working systems.

Telegraphic measurements; measuring and testing lines for conductivity, insulation, location of faults, etc. (2)

PHYSICAL CULTURE.

The Gymnasium is open morning, afternoon and evening, in all, 45 hours a week. Exercise in it is required of all students who are fitted to take it. Class drill with the Instructor and individual exercise are prescribed.

GRADUATING THESES.

Every student will be required to present a thesis upon some topic connected with his special course, as a necessary portion of the exercises for his final examination for a diploma. These theses shall be accompanied by drawings and diagrams, when the subjects need such illustration. The originals will be kept by the University, as a part of the student's record, for future reference; but a copy may be retained by the student, and be published, permission being first obtained from the President.

DIPLOMAS AND CERTIFICATES.

The Diploma is given only to those who have passed all the examinations in a regular course and is signed by the President and Secretary of the Board of Trustees and by the Faculty of the University. For all the partial courses a certificate, signed by the President and the Secretary of the Faculty, is given showing what the student has accomplished.

GRADUATE STUDENTS.

Graduate students wishing to remain a year or more and pursue a course of study as candidates for another Degree may do so with the sanction of the Faculty. Those wishing to take *special* courses of study will be afforded every facility for so doing.

POST GRADUATE DEGREES.

M. A.

The Faculty will recommend for the Degree of Master of Arts any Candidate, otherwise properly qualified, who, after taking at this University the Degree of Bachelor of Arts, shall pursue, for at least one year at this University, or two years elsewhere, a course of liberal study prescribed by the Faculty in at least two departments, pass a satisfactory examination in the same and present a satisfactory Thesis.

M. S.

The Faculty will recommend for the Degree of Master of Science any Candidate, otherwise properly qualified, who, after taking at this University the Degree of Bachelor of Science, or any Degree in the School of Technology, shall pursue, for at least one year at this University, or two years elsewhere, a course of study prescribed by the Faculty in at least two departments, pass a thorough examination in the same and present a satisfactory Thesis.

Ph. D.

The Faculty will recommend for the Degree of Doctor of Philosophy any Candidate, otherwise properly qualified, who, after taking at this University the Degree of Master of Arts or Master of Science, shall pursue, for at least one year at this University, or two years elsewhere, a course of advanced study prescribed by the Faculty, in at least two departments, pass a thorough examination in the presence of the Faculty in the same and present a satisfactory Thesis giving evidence of original investigation.

The Candidate shall have a good knowledge of Latin and either French or German.

The Theses presented by Candidates for Post Graduate Degrees shall be retained by the University.

Applicants for any of these degrees will be required to complete the prescribed work within the allotted time. Special action of the Faculty is required for any extension of time.

THE UNIVERSITY LIBRARY.

The Library building was erected by the Founder of the University in 1877, at a cost of One Hundred Thousand Dollars, as a memorial of his daughter, Mrs. Lucy Packer Linderman, and during the same year more than Twenty Thousand Dollars were contributed by her family and friends, as a memorial fund for the purchase of books. By the will of the Founder of the University a fund of $500,000 has been given for the permanent endowment of the library.

The building is semi-circular in plan, with a handsome façade in the Venetian style of architecture. It is constructed of Potsdam sandstone with granite ornamentation. In the interior, the center is occupied as a reading space, fifty by forty feet, from which radiate the book cases, extending from floor to ceiling; two galleries affording access to the upper cases. Shelf room is now provided for one hundred and sixty thousand volumes. The building is thoroughly fireproof, well lighted, and heated by steam.

Sixty-seven thousand volumes are now upon the shelves, including many extremely valuable works. The list of periodicals numbers about one hundred and twenty-five, embracing as far as possible all departments of knowledge.

The Library is conducted strictly for consultation, and is open to the use of the public; both of which conditions are in accord with the terms of the gift.

REGULATIONS OF THE LEHIGH UNIVERSITY LIBRARY.

I. The Library is open every day, except Sundays and Legal Holidays, from 8 A. M. until 10 P. M., and on Sundays for the students and others connected with the University from 1.30 P. M. until 9.30 P. M.

II. Admission is free to all persons over 16 years of age.

III. Readers are required to write their names and addresses in the Daily Register of the Library. They also write the name of the book desired upon a Library Card, with their signatures, and present the same to the Director's Clerk, who supplies the book, retaining the card as a receipt. Before leaving the Library, readers return their books to the clerk, and receive their cards.

IV. The University Professors and Instructors, only, are allowed to take books from the Library Building.

V. No person is allowed to enter the alcoves, or remove any book from the shelves, without permission of the Director.

VI. Readers wishing to consult the more valuable illustrated works make special application for that purpose.

VII. In taking notes, pencils, and not pens and ink, are to be used.

VIII. Audible conversation and the use of tobacco are strictly forbidden in any part of the Library.

IX. Any person not conforming to these Regulations, will be denied the privilege of the Library.

X. Any person, who defaces, in any way, any book, magazine or paper, or the furniture, or any portion of the building, in addition to being deprived of the privileges of the Library, will be prosecuted according to law.

OBSERVATORY.

By the liberality of Robert H. Sayre, Esq., one of the Trustees of the University, an Astronomical Observatory was erected on the University grounds, and placed under the charge of the Professor of Mathematics and Astronomy.

In the dome of the Observatory is mounted an Equatorial Telescope, of six inches aperture, by Alvin Clark & Sons. The west wing contains a superior Sidereal Clock, by Wm. Bond & Sons; a Zenith Telescope, by Blunt, and a Field Transit, by Stackpole. There is also a Prismatic Sextant, by Pistor & Martins.

Students in Practical Astronomy receive instruction in the use of the instruments and in actual observation.

The grounds upon which the Observatory stands, consisting of seven acres of land adjoining the original grant, was presented to the University by Charles Brodhead, Esq., of Bethlehem.

An advanced course in Astronomy and the higher Analysis has been established, requiring two years for its completion. It is adapted to the attainments of the graduates of this University, but, is open to any one who may be prepared to pursue it.

This course embraces the following subjects:

First Year.—Spherical Astronomy. Theory of Instruments. Method of Least Squares. Numerical Calculus.

Second Year.—Celestial Mechanics. Interpolation and Quadrature. Computation of Orbits and Perturbations.

During the entire course the student will have ample opportunity to familiarize himself with the practical work of the Observatory and Computing Room.

THE PACKER MEMORIAL CHURCH,

is the recent and munificent gift of Mrs. Mary Packer Cummings, daughter of the Founder of the University. It is a large and magnificent Church, richly furnished and handsomely appointed in every particular. There is no more beautiful Church edifice in the State and it is one of the noblest in all the land. It is under the Rectorship of the Right Reverend Nelson Somerville Rulison, D.D., Assistant Bishop of Central Pennsylvania, with the Chaplain of the University as Assistant.

THE UNIVERSITY MUSEUM.

In addition to the large collection illustrating all branches of Industrial Chemistry, the Museum includes collections in Metallurgy, Geology, Zoology, and Archæology.

The Metallurgical Cabinet already includes specimens illustrating the various processes for obtaining the more common metals.

The Zoological Cabinet includes the Werner collection of nearly all the types of American birds with their nests and eggs, and the Packer collection of recent shells.

The Geological Cabinet numbers over ten thousand specimens and includes the Palæontological, Mineralogical, Petrographic and Economic collections. The former contains good specimens of nearly all the common genera. The Mineralogical division includes the Keim and Rœpper collections—the latter being especially complete and valuable from a crystallographic stand-point. The Petrographic division numbers several thousand specimens and besides including numerous varieties of nearly all the rocks of the globe, contains a duplicate set from the collection of the Second Geological Survey of this State. The Economic division was formed and donated by Dr. James P. Kimball, Director of the Mint, and formerly Professor of Economic Geology.

The Cummings Archæological Cabinet numbers three thousand specimens and includes Dr. Stubbs' Collection of Indian relics, weapons, and utensils.

THE ENGINEERING SOCIETY.

This society was organized in 1873, and admits, by election, students in the Junior and Senior Classes. Its meetings are held fortnightly. At these, papers relating to engineering subjects are read and discussed. It issues quarterly "The Journal of the Engineering Society" to which the members and others contribute.

THE MINING CLUB.

This was organized in 1883 and takes from the Junior, Senior, and Post Senior Classes, those members of the Mining School who excel in their studies or in practical experience in the subjects of the course.

THE ELECTRICAL ENGINEERING SOCIETY

was organized in November, 1887, by students in the Advanced Course in Electricity. Its object is to supplement the regular work of the department by the study and discussion of electrical subjects.

THE AGORA

is a Literary Society which meets semi-monthly—only students in the Course of General Literature are eligible to membership.

THE ATHENÆUM.

is also a Literary Society whose active membership is confined to the Sophomore Class. The meetings are held weekly.

FOUNDER'S DAY

On the second Thursday of October of each year Commemorative Exercises are held in honor of the Founder of the University.

On Thursday, October 13, 1887, the Ninth Founder's Day was celebrated. The Memorial Church was consecrated. The Bishop of Central Pennsylvania was the Consecrator, and the Bishop of New York was the preacher.

WASHINGTON'S BIRTHDAY.

This day is observed as a holiday.

On Tuesday, February 22, 1887, exercises were held in the Chapel. "An Essay on Washington as a Chief Mover in Federal Government" was read by Prof. Wm. A. Lamberton, and orations were delivered by Messrs. Domenech, Rau, Baldwin, Dravo, and Wiseman of the Junior Class.

UNIVERSITY SERMON.

This sermon is preached on the Sunday before University Day.

The Rt. Rev. Nelson S. Rulison, D.D., Assistant Bishop of Central Pennsylvania, was the preacher on Sunday, June 19, 1887, in the Memorial Church.

THESES.

Theses on the following subjects were prepared by the graduating class of 1887.

"A Theoretical and Practical Investigation of Railroad Rail-Joints."

ALEXANDER BONNOT.

"An Examination of the Zinc Blende from Friedensville, Pa."

CHARLES AUSTIN BUCK.

"Design of a Boiler for a Passenger Locomotive."

JULIAN CARTER BUCKNER.

"Plan and Estimate for a Water Supply for the Lehigh University."

BENJAMIN AMOS CUNNINGHAM.

"Comparison of Two Types of Steam Fire-Engines."

EUGENE DIVEN.

"The Life and Work of Socrates.

ALFRED DOOLITTLE.

"Influence of Mohammedanism on European Civilization."

MILTON HENRY FEHNEL.

"The Politics of Aristotle."

HARVEY SHEAFE FISHER.

"Ruskin on the Labor Question."

KENNETH FRAZIER.

"Steam Heating."

HENRY STEVENS HAINES, JR.

"The Three-Point Problem and its Application to the Finding of a Lost Station."

JOHN BENJAMIN FRANKLIN HITTELL.

"Friction."

JOHN MYERS HOWARD.

"Design of Pumping Engines for the City of Scranton."

WILLIAM FREDERICK KIESEL, JR.

"Discussion of the Errors in Precise Leveling."

JAMES WESSON KITTRELL.

"Discussion of the Precision of the Sægmüller Solar Attachment."

JOHN WALTER LADOO.

"Design of a Direct-Acting Steam Pump."

SAMUEL DAVIS LANGDON.

"The Drainage of the Borough of Bethlehem, with a Plan for the Improvement of the Streets."

FREDERICK BOWMAN LANGSTON, JR.

"The Equal and Righteous Administration of Justice."

GARRETT BRODHEAD LINDERMAN, JR.

"Review of the New Sewage System of the City of Chicago."

WILLIAM ANTHONY LYDON.

"Design of a Roof Truss of 100 Feet Span."

HARRY SMULLER MEILY.

"Design and Estimate of Cost for an Impounding Reservoir on Mill Run, near Altoona, Pa."

JAMES ALEXANDER MORROW.

"The Fireless Locomotive."

GEORGE FRANCIS PETTINOS.

"Plan and Estimate for a Suburban Railroad for Washington, D. C."

ROBERT HENRY PHILLIPS.

"Design and Estimate for a Cable Railway for Bethlehem."

CHARLES POPE POLLAK.

"An Investigation of the Easton and South Easton Suspension Foot-Bridge."

MASON DELANO PRATT.

"An Experimental Investigation of the Stiffening Girders of Suspension Bridges."

EVAN TURNER REISLER.

"The Practical Determination of an Azimuth."

GEORGE THOMAS RICHARDS.

"Design of a Machine for Binding Books."

JOHN WARWICK SCULL.

"On the Solubility of the Oxides of the Common Metals in Water Glass."

FRANK STUART SMITH.

"The Flow of Water over Wiers, with a Discussion of the Experiments made by the Class of 1887 on the Wier in the Hydraulic Laboratory of Lehigh University."

ELMER ELLIS SNYDER.

"The Geology of the Salem Coal Basin, Shickshinny, Pa.

EDWIN STANTON STACKHOUSE.

"Discussion of Recent Experiments on Friction."

OTWAY OWEN TERRELL.

"The Preparation of Anthracite Coal, with a Review of the Deringer Breaker."

PRIESTLEY TOULMIN.

"Blow Holes in Bessemer Steel Castings."

AUGUST JULIUS WIECHARDT.

"Review of the Water Supply of Allentown, Pa.

NISSLEY JOSEPH WITMER.

"Capital Punishment."

WADE HAMPTON WOODS.

"Design of a Boring Machine for Large Cylinders."

GEORGE FREDERIC YOST.

"The Early Institutional History of Virginia and Massachusetts."

CHARLES FREDERIC ZIMMELE.

THE ADDRESS BEFORE THE ALUMNI

was delivered on the evening of Alumni Day, June 22, 1887, in the Chapel of the University, by Francis A. Walker, Ph.D., LL.D., President, Massachusetts Institute of Technology.

UNIVERSITY DAY.

This day is the last of the academic year and falls in 1888 on the fourth Thursday in June. On this day orations are delivered by members of the Graduating Class, and Degrees are conferred.

EXERCISES ON JUNE 23, 1887.

Reading of Scriptures and Prayer by the Rt. Rev. A. M. de Wolfe Howe, D.D., LL.D., Bishop of the Diocese.

Salutatory Oration.—"The Dark Continent."

HARRY HARKNESS STOEK.

Oration.—"The Age of Engineering."

ROBERT HENRY PHILLIPS.

Oration.—"Love of Country."

CHARLES FREDERIC ZIMMELE.

Oration.—"The Labor Problem."

JOHN MYERS HOWARD.

Oration.—"Man's Inhumanity to Man."

HARVEY SHEAFE FISHER.

Oration, with the Valedictory Addresses.—"Civilized and Uncivilized.

MILTON HENRY FEHNEL.

Award of the Wilbur Scholarship to
JOHN LOCKETT
of Glengoffe, Jamaica, first in rank in the Sophomore Class, with honorable mention of
SAMUEL ERWIN BERGER
of Richland Centre, to whom was awarded the Wilbur Prize.

Award of Certificates for the Advanced Course in Electricity.

The following degrees were conferred:

B.A.

ALFRED DOOLITTLE,
HARVEY SHEAFE FISHER,
KENNETH FRAZIER.

B.Ph.

CHARLES FREDERIC ZIMMELE,
GARRETT BRODHEAD LINDERMAN.

B.S.

MILTON HENRY FEHNEL,
WADE HAMPTON WOODS.

C.E.

ALEXANDER BONNOT,
ROBERT HENRY PHILLIPS,
BENJAMIN AMOS CUNNINGHAM,
CHARLES POPE POLLAK,
JOHN BENJAMIN FRANKLIN HITTEL,
MASON DELANO PRATT,
JAMES WESSON KITTRELL,
EVAN TURNER REISLER,
FREDERICK BOWMAN LANGSTON,
GEORGE THOMAS RICHARDS,
JOHN WALTER LADOO,
ELMER ELLIS SNYDER,
HARRY SMULLER MEILY,
NISSLEY JOSEPH WITMER,
JAMES ALEXANDER MORROW,

M.E.

JULIAN CARTER BUCKNER,
SAMUEL DAVIS LANGDON,
EUGENE DIVEN,
GEORGE FRANCIS PETTINOS,
HENRY STEVENS HAINES, JR.,
JOHN WARWICK SCULL,
JOHN MYERS HOWARD,
OTWAY OWEN TERRELL,
WILLIAM FREDERICK KIESEL, JR.
AUGUST JULIUS WIECHARDT,
GEORGE FREDERIC YOST.

B.S.

ROBERT WEBB BARRELL,
EDWARD POWER VAN KIRK.

B.S.

(In Mining and Metallurgy.)

CHARLES COLCOCK JONES,
HARRY HARKNESS STOEK,
HENRY BENJAMIN CHARLES NITZE,
HENRY AUGUST JULIUS WILKENS,
RUFUS KING POLK,
FRANK WILLIAMS.

A.C.

CHARLES AUSTIN BUCK,
FRANK STUART SMITH.

E.M.

WILLIAM ANTHONY LYDON, B.M.,
EDWIN STANTON STACKHOUSE, B.M.,
PRIESTLEY TOULMIN, B.M.

The Benediction was then pronounced by the Bishop.

THE WILBUR SCHOLARSHIP.

This Scholarship was founded in 1872 by E. P. Wilbur, Esq., of South Bethlehem, and is the sum of $200 awarded annually to the student in the Sophomore Class having the best record.

THE ALUMNI SCHOLARSHIP.

The Alumni Association of the University has established a Scholarship of the value of $250 per annum, subject to the following conditions:

1. That the Scholarship shall only be awarded to a student really in need of it.

2. That the Scholarship shall not apply to the first year of any student's course; he must without this aid have gone through one year, and must be prepared to start the second year free from all conditions.

3. That the Scholarship shall not be continued to a student who shall at any time during his course carry any condition over eight weeks beyond the date of the examination in which he failed.

Subject only to the above conditions the disposal of the fund shall until otherwise directed be in the hands of the President of the University.

WILBUR PRIZE.

By the generosity of E. P. Wilbur, Esq., a fund has been established yielding an annual income of $100, for distribution in prizes as the Faculty shall determine.

ALUMNI PRIZES FOR ORATORY.

The "Alumni Association of the Lehigh University" has established an Annual Sum of Fifty Dollars, to be distributed as prizes for excellence in Oratory, subject to the following

REGULATIONS.

1. The Contest shall be held on the 22d day of February, or on the day designated by the University to commemorate the birthday of Washington.

2. There shall be a first prize of $25, a second of $15, and a third of $10.

3. To entitle one to be a competitor he must be a member of the Junior Class, taking a regular course.

4. Subjects for the oration shall be announced at the beginning of the first Term of every year and upon one of these, each competitor shall write an oration not to exceed eight minutes in delivery.

5. Each oration shall bear upon its first page a fictitious name or motto, and shall be accompanied by a sealed envelope, which shall be superscribed with the same name or motto, and an address by which it may be reclaimed. The envelope shall contain the real name and address of the writer, with the declaration that the oration is his own original work. The examiner, having adopted a standard of excellence, may reject any or all of the orations presented which do not attain to this standard; of such as do —should they be sufficient in number—the best six shall be chosen, and their envelopes opened. The others shall be retained to the address given with their envelopes unopened.

6. The Executive Committee of the Alumni Association, or a committee of not fewer than three to be appointed by them, shall hear the competitors, whose oration shall have been approved, and the awards shall be made by a majority of these Judges.

7. In awarding the prizes the judges shall consider both the literary merits and the delivery of each oration.

8. These rules are subject to amendment by the Faculty.

At the last contest, the First Prize was awarded to

ALBERT GEORGE RAU,

the Second, to

GEORGE READE BALDWIN,

and the Third, to

EDWARD BENJAMIN WISEMAN.

The next contest will take place February 22, 1888.

ENTRANCE EXAMINATION PAPERS.

Used at the Examination in 1887.

[Requests for other examination papers than those herein printed can not be granted.]

I.—ENGLISH GRAMMAR.

1. State the different ways of forming the plural of nouns, with examples.
2. Specify some nouns that have plural forms of different meaning.
3. Decline some compound personal pronoun.
4. How are tenses formed?
5. Give examples of correlative conjunctions.
6. Why can not an adjective be the subject of a sentence.
7. What is essential to a complete sentence?
8. In what grammatical relation do interjections stand to the rest of the sentence?
9. Write down the plurals of sheaf, chimney, duty, echo, dray, army, loaf, grove, stuff, staff, scarf, speech, pony, hoof, box, tooth, colloquy, thief, goose, deer, brother.
10. In spelling, what does a double consonant usually show?
11. Supply relative pronouns in these sentences:—Which was the road you took? He is not the man I expected. Have you received the money I sent you? Be reconciled with the man you offended.
12. What is meant by adverbs modifying the meaning of words?
13. What is a reflective pronoun, and how used?
14. Give examples of ordinal numerals.
15. Write down a sentence in which a phrase stands as subject of the verb.
16. How can the meaning of the possessive case be otherwise expressed?

17. Parse the sentence:—"Death to man in misery is sleep?"

18. Analyze the sentence:—"I had a dream, which was not all a dream."

19. Express the sense of the following by means of the passive voice of the same verbs:—(1) He hates lying. (2) That surprised me. (3) I had not expected this.

20. Parse *that* in the following sentences:—(1) Look at that star. He does that, that he may vex me. (3) That is certain. (4) He is the very man that I want.

II.—GEOGRAPHY.

1. Bound the State in which you live.

2. In what States or Territories are Memphis, Toledo, Milwaukee, Vergennes, and Eastport?

3. Locate the following rivers: Red, Dan, Penobscot, Wabash, and Rock.

4. Name and locate the capitals of Maine, Western Virginia, Nebraska, Mississippi, and Nevada.

5. Locate Sierra Nevada, Lake Itasca, Blue Ridge, Saut Ste. Marie, and Green Bay.

6. Locate Moscow, Riga, Toulon, Nice, and Aukland.

7. Give the principal city in Bulgaria, Tasmania, Saxony, Belgium, and Iceland.

8. Locate the Niger, Don, Rhone, Volga, and Shannon.

9. Locate the Balkan Mountains, Island of Trinidad, Sea of Marmora, Lake of Geneva, and Bay of Biscay.

10. Through what waters would you sail westward from Vancouver's Island to London by the most direct route?

III.—UNITED STATES HISTORY.

1. When and to whom was Georgia granted? Where was the first settlement made? Who were the settlers? When was slavery introduced? When did the war with Spain begin?

2. Name the four Acts passed by Parliament which the colonies could not help resisting?

3. Where was the Treaty of Alliance with France concluded? What was agreed on in the Treaty?

4. What were the leading events of John Adams' administration?

5. When and by whom was made the first serious attack on slavery? What name was given to the anti-slavery men? What was the effect on the South?

6. What was the subject of the Dred Scott Decision? And what did the Supreme Court decide?

7. What was the feeling of foreign nations at the outbreak of the war of Secession?

8. What was the Tenure of Office Act? Did President Johnson submit to it? Why was he impeached? By whom is the impeachment to be tried?

9. How are the Presidential Electors chosen, and how many Electors are chosen by each State?

10. Who retains the rights not given to the United States, or forbidden to the States.

IV.—ARITHMETIC.

1. (*a*) What is the highest common divisor of two or more quantities?

(*b*) Explain method of adding fractions.

(*c*) Having the difference of longitude between two places, how is the difference in time determined?

2. (*a*) What are the dimensions of a vessel which will hold one litre? How many quarts in a litre?

(*b*) Give number of pints in a quart; quarts in gallon? gallons in barrel; inches in link; links in chain; square chains in acre?

(*c*) What are assets and liabilities? When is stock said to be par?

3. Divide $[2\frac{1}{3} - \frac{7}{2} + 0.3]$ by $[19\frac{1}{4} - 7\frac{1}{10} + 1]$, reduce to decimal, and explain how position of decimal point is found.

4. Reduce 40.0973 kilometres to miles, rods, feet, and inches.

5. Having sold 30% of my land I have 17 acres remaining. How much had I at first?

6. Find interest, discount, and bank discount on $65.33 for 90 days at 4½%.

7. How much water must be mixed with wine worth $0.90 per gallon to make a mixture worth $0.60 per gallon?

V.—GEOMETRY.

1. (*a*) What is a polygon? a triangle? a regular polygon? a circle?

(*b*) What are the cases in which two triangles are equal? When are they similar?

(*c*) What is a tangent? a secant? a chord? a sector? a segment?

2. (*a*) When is a figure said to be symmetrical with respect to an axis? when with respect to a point?

(*b*) What is the measure of an inscribed angle? of an angle formed by a tangent and chord? of the angle formed by two secants?

(*c*) What is the value of the circumference of a circle in terms of the radius? of the area of a circle? the area of a sector?

3. The sum of all the angles of a polygon is equal to two right angles taken as many times less two as the polygon has sides.

4. Every point in the bisector of an angle is equally distant from the sides of the angle, and every point not in the bisector but within the angle is unequally distant from the sides.

5. In the same circle, or in equal circles, equal chords are equally distant from the center; and of two unequal chords, the less is at the greater distance from the center.

6. Upon a given straight line to describe a segment which shall contain a given angle.

7. If a straight line divides two sides of a triangle proportionally it is parallel to the third side.

8. To divide a given straight line in extreme and mean ratio.

9. The square described on the hypothenuse of a right angled triangle is equal to the sum of the squares described on the other two sides.

10. Given the perimeters of the regular inscribed and the similar circumscribed polygon, to compute the perimeters of the regular inscribed and circumscribed polygon of double the number of sides.

11. Of all triangles having the same base and equal areas, that which is isosceles has the minimum perimeter.

12. The sum of the face-angles of any convex polyedral angle is less than four right angles.

VI.—ALGEBRA.

1. (*a*) Give definitions of binomial; polynomial; monomial.

(*b*) Explain how one fraction is divided by another.

(*c*) What is the least common multiple of two or more numbers?

2. (*a*) What is the reciprocal of a quantity? What is the reciprocal of zero?

(*b*) What are involution and evolution?

(*c*) What is a radical? What is an imaginary quantity?

3. (*a*) What is the form to which every imaginary monomial may be reduced?

(*b*) What is the form to which every equation of the second degree may be reduced?

(*c*) Give formulæ for the nth term and for the sum of n terms of a geometrical progression.

4. Find the highest common divisor of

$$2x^3 + 5 - 8x + x^2 \quad \text{and} \quad 42x^2 + 30 - 72x.$$

5. Reduce the following to equivalent expressions having rational denominators:

$$\frac{x}{x + \sqrt{y}}; \quad \frac{3 + 2\sqrt{2}}{\sqrt{5} - \sqrt{3}}; \quad \frac{2}{\sqrt{5} + \sqrt{3} - \sqrt{2}}.$$

6. 875.021. Extract the square root, and give reasons for the various operations.

7. Solve the following equations:

$$\frac{9x+20}{36} = \frac{4x-12}{5x-4} + \frac{x}{4}; \qquad \sqrt{a+\sqrt{x}} + \sqrt{a-\sqrt{x}} = \sqrt{x}.$$

8. Divide a into two parts such that the sum of the quotients which are obtained by dividing one part by m and the other by n shall be equal to b.

9. Solve the following equations:

$$\left\{\begin{array}{l} ax + by = c \\ cx + az = b \\ bz + cy = a \end{array}\right\}; \qquad \left\{\begin{array}{l} x + y = 4 \\ \frac{1}{x} + \frac{1}{y} = 1 \end{array}\right\}.$$

10. $$\frac{a}{x} + \frac{\sqrt{a^2 - x^2}}{x} = \frac{x}{b}; \qquad x = \frac{12 + 8\sqrt{x}}{x - 5};$$

$$(x - a)(x + b)(x - \tfrac{1}{2}) = 0.$$

VII.—PHYSICS.

1. Define (*a*) Atom.
   (*b*) Molecule.
   (*c*) Erg.
   (*d*) Moment of a force.
2. Give the laws of
   (*a*) The lever.
   (*b*) The pendulum.
   (*c*) The pulley.
3. How long must a pendulum be to vibrate minutes?
4. Determine the specific gravity of granulated tin from the following data:

Weight of bottle filled with water at 60° F., 44.378 grammes.
" " tin, ... 9.431 "
" " bottle, tin and water, ... 52.515 "

5. What is a wave length?
6. If 4 lbs. of water at 60° C., 5 lbs. at 80° C., and 7 lbs. at 100° C. are mixed, what will be the resulting temperature?
7. What effect has distance on radiant heat?
8. Give the laws of refraction of light.

9. A lamp 30 ft. from a screen throws a shadow which is just equal to that made by a candle 5 ft. from the screen, what is the relative intensity of the two lights?

10. What is the best method of finding the best arrangement of the cells of a voltaic battery?

11. Describe a Dynamo. (Give its essential parts and their arrangement.)

12. What is the voltaic arc?

13. If the resistance of 130 yds. of copper wire $\frac{1}{16}$ in. in diameter is one ohm, what will be the resistance of 8,242 yds. of the same copper wire?

VIII.—LATIN.

I.—GRAMMAR.

1. Decline throughout, with the adjective *nullus*, the following nouns: *homo*, *dies*, *exsul*, *opus*, *princeps*. What other words are declined like *nullus?*

2. Write the genitive singular of *frigus*, *virus*, *nemus*, *limen;* and the nominative singular of *salutem*, *sitim*, *litore*, *silicis*, *vulnera*, *aethere*, *sulcis*.

3. Compare *fortis*, *difficilis*, *parvus*, *miser*. Form and compare the corresponding adverbs. From what adjectives are *prudenter*, *acriter*, and *parum* derived?

4. Distinguish *hic*, *iste* and *ille; quidam* and *quisquam*. When is the interrogative *quis* used, and when *qui?* Is there any difference between the inflection of *quis* (interrogative) and *quis* (indefinite)?

5. Discuss the meaning of each part of the word *aud-i-vi-m-us*.

6. What is a suffix, an affix, a radical, a stem, a root, an inflection? Explain the term "etymology."

7. Give the principal parts of the verbs from which the following forms are derived: *peteretur*, *aluut*, *praebent*, *perculsum*, *abiectum*, *canit*.

8. Write out in full the present tense of *volo*, *fio*, *fero*, *nolo*, *feror*, *prosum*. What is the deriviation of *malo*, *possum*, *nolo?*

9. How do you distinguish between verbs of various conjugations? What is the conjugation of *cantare*, *canere*,

struere, stare, aperire, cupere, tenere, elicere, cumbere, sancire, inveterascere, crepare, fugere, ardere, metere, plorare?

10. What is the gender of *manus, sermo, pes, compes, fraus, nubes, vannus, ratio?* Is this sentence correct: *Humus est humidus?* Give the reason for your answer.

II.—CAESAR.

Translate:

Ad haec Caesar, quae visum est, respondit; sed exitus fuit orationis: "Sibi nullam cum his amicitiam esse posse, si in Gallia remanerent; neque verum esse, qui suos fines tueri non potuerint, alienos occupare; neque ullos in Gallia vacare agros, qui dari, tantae praesertim multitudini, sine iniuria possint; sed licere, si velint, in Ubiorum finibus considere, quorum sint legati apud se et de Sueborum iniuriis querantur et a se auxilium petant; hoc se Ubiis imperaturum." - *B. G., IV.*, 8.

Change the words of Caesar to direct discourse.

III.—VIRGIL.

Translate:

D. Vis ergo inter nos, quid possit uterque, vicissim
Experiamur? Ego hanc vitulam—ne forte recuses,
Bis venit ad mulctram, binos alit ubere fetus—
Depono: tu dic, mecum quo pignore certes.
M. De grege non ausim quicquam deponere tecum:
Est mihi namque domi pater, est iniusta noverca:
Bisque die numerant ambo pecus, alter et haedos.
Verum, id quod multo tute ipse fatebere maius,
Insanire libet quoniam tibi, pocula ponam
Fagina, caelatum divini opus Alcimedontis:
Lenta quibus torno facili superaddita vitis
Diffusos hedera vestit pallente corymbos.

Ecl., III., 28-39.

1. In what sense does he use *vicissim?* 2. On what does *experiamur* depend? 3. Explain *ausim* and *domi.* 4. What is the grammatical antecedent of *quod* (line 8)? 5. Construction of *multo?* 6. Where did bucolic poetry originate?

Translate:

Ergo iter inceptum peragunt, fluvioque propinquant
Navita quos iam inde ut Stygia prospexit ab unda
Per tacitum nemus ire pedemque advertere ripae,
Sic prior aggreditur dictis atque increpat ultro:
"Quisquis es, armatus qui nostra ad flumina tendis,
"Fare age, quid venias, iam istinc et comprime gressum.
"Umbrarum hic locus est, Somni Noctisque soporae;
"Corpora viva nefas Stygia vectare carina."

Aen., VI., 334–391.

1. What is the object of *prospexit*?
2. With what is *iam istinc* to be joined?
3. Prosody:—*a*. Define the quantity of the final syllable of words more than one syllable, and the quantity of words of one syllable.
   b. Divide the last four lines of this passage into feet and mark the rhythmic accent.
   c. Give the reasons for your division.

IV.—CICERO.

Translate:

Quae cum ita sint, Catilina, dubitas, si emori aequo animo non potes, abire in aliquas terras et vitam istam, multis suppliciis iustis debitisque ereptam, fugae solitudinique mandare? "Refer" inquis "ad senatum;" id enim postulas, et, si hic ordo sibi placere decreverit te ire in exsilium, obtemperaturum te esse dicis. Non referam, id quod abhorret a meis moribus, et tamen faciam ut intelligas, quid hi de te sentiat. Egredere ex urbe, Catilina, libera rempublicam metu, in exsilium, si hanc vocem expectas, proficiscere. Quid est, Catilina? Ecquid attendis, ecquid animadvertis horum silentium? Patiuntur, tacet. Quid exspectas auctoritatem loquentium, quorum voluntatem tacitorum perspicis? – *Cat.* I., 8.

Translate:

Municipiis dispertiri iubet. Habere videtur ista res iniquitatem, si imperare velis; difficultatem, si rogare. Decernatur tamen, si placet. Ego enim suscipiam, et ut spero, reperiam, qui id, quod salutis omnium causa

statueritis, non putent esse suae dignitatis recusare. Adiungit gravem poenam municipiis, si quis eorum vincula ruperit; horribiles custodias circumdat et digna scelere hominum perditorum. Sancit ne quis eorum poenam, quos condemnat, aut per senatum aut per populum possit levare: eripit etiam spem, quae sola homines in miseriis consolari solet.—*Cat. IV.*, 4.

1. Whose opinion is here stated? 2. Who proposed the opposing opinion and what was it?

V.—SIGHT READING.

Translate (Cæsar, *B. G.*, *VI.*, 18):

Galli se omnes ab Dite patre prognatos praedicant, idque ab Druidibus proditum dicunt. Ob eam causam spatia omnis temporis non numero dierum, sed noctium finiunt; dies natales et mensium et annorum initia sic observant, ut noctem dies subsequatur. In reliquis vitae institutis hoc fere ab reliquis differunt, quod suos liberos, nisi cum adoleverunt, ut munus militiae sustinere possint, palam ad se adire non patiuntur filiumque puerili aetate in publico in conspectu patris adsistere turpe dicunt.

Translate (Cicero, *Epist.*, *XIII.*, 28):

Hegeseratus Larissaeus magnis meis beneficiis ornatus in consulatu meo memor et gratus fuit, meque postea diligentissime coluit. Eum tibi magno opere commendo ut et hospitem meum et familiarem et gratum hominem et virum bonum et principem civitatis suae et tua necessitudine dignissimum. Pergratum mihi feceris, si dederis operam ut is intelligat hanc meam commendationem magnum apud te pondus habuisse.

VI.—COMPOSITION.

1. Caesar moves his camp, and in about fifteen days arrives at the boundaries of the Belgae. 2. I have lived in Rome, Carthage, Athens, Naples and Corinth: and have now been three years at home in Gaul. 3. I sent a man to Caesar, to tell him this. 4. When you come, I shall go away (*abeo*). 5. Cicero was six years older than Caesar. 6. This book will be of great value to us. 7. He said that

this plan would be useful to all the states. 8. Let us ask them their opinion in regard to this calamity. 9. The Germans were not ashamed of their valor. 10. Many states sent embassadors to Rome to establish peace and friendship with the Roman people.

VII.—HISTORY.

1. Relate the traditions concerning the origin of Rome.
2. Describe the reign of Tarquinius Superbus.
3. Describe the causes and effects of the first secession.
4. Describe the conspiracy of Catiline.
5. Describe the decisive battles of Pharsalia, Philippi, and Actium.

IX.—GREEK.

Οἱ μὲν δὴ στρατηγοὶ οὑτω ληφθέντες ἀνήχθησαν ὡς βασιλέα καὶ ἀποτμηθέντες τὰς κεφαλὰς ἐτελεύτησαν· εἷς μὲν αὐτῶν Κλέαρχος ὁμολογουμένως ἐκ πάντων τῶν ἐμπείρως αὐτοῦ ἐχόντων δόξας γενέσθαι ἀνὴρ καὶ πολεμικὸς καὶ φιλοπόλεμος ἐσχάτως. Καὶ γὰρ δὴ, ἕως μὲν πόλεμος ἦν τοῖς Λακεδαιμονίοις πρὸς τοὺς Ἀθηναίους παρέμενεν· ἐπεὶ δὲ εἰρήνη ἐγένετο, πείσας τὴν ἑαυτοῦ πόλιν ὡς οἱ Θρᾷκες ἀδικοῦσι τοὺς Ἕλληνας καὶ διαπραξάμενος ὡς ἐδύνατο παρὰ τῶν Ἐφόρων ἐξέπλει ὡς πολεμήσων τοῖς ὑπὲρ Χερρονήσου καὶ Περίνθου Θρᾳξίν. Ἐπεὶ δὲ μεταγνόντες πως οἱ Ἔφοροι, ἤδη ἔξω ὄντος αὐτοῦ, ἀποστρέφειν αὐτὸν ἐπειρῶντο ἐξ Ἰσθμοῦ, ἐνταῦθα οὐκέτι πείθεται ἀλλ' ᾠχετο πλέων εἰς Ἑλλήσποντον. Ἐκ τούτου καὶ ἐθανατώθη ὑπὸ τῶν ἐν τῇ Σπάρτῃ τελῶν ὡς ἀπειθῶν. Ἡδη δὲ φυγὰς ὢν ἐρχεται πρὸς Κῦρον, καὶ ὁποίοις μὲν λόγοις ἔπεισε Κῦρον ἄλλῃ γέγραπται· δίδωσι δὲ αὐτῷ Κῦρος μυρίους δαρεικούς· ὁ δὲ λαβὼν οὐκ ἐπὶ ῥᾳθυμίαν ἐτράπετο ἀλλ' ἀπὸ τούτων τῶν χρημάτων συλλέξας στράτευμα ἐπολέμει τοῖς Θρᾳξί, καὶ μάχῃ τε ἐνίκησε καὶ ἀπὸ τούτου δὴ ἔφερε καὶ ἦγεν αὐτούς· καὶ πολεμῶν διεγένετο, μέχρι Κῦρος ἐδεήθη τοῦ στρατεύματος· τότε δὴ ἀπῆλθεν ὡς ξὺν ἐκείνῳ αὖ πολεμήσων.

Decline: Οἱ, στρατηγοί, ληφθέντες, κεφαλάς, αὐτοῦ, ἀνήρ, Ἕλληνας, ὄντος, τελῶν, τούτων, πάντων, πόλιν, στράτευμα, συλλέξας.

Compare: πολεμικός, πρῶτος, ὕστατος, σαφής, ταχύς, ἡδύς, εὖ, καλός, κακός.

Give the principal parts of: ληφθέντες, ἐτελεύτησαν, παρέμενεν, πείσας, ἐδύνατο μεταγνόντες, ἔρχεται, γέγραπται, ἔχόντων.

Give the following tenses in full: pres. ind. act. of ληφθέν-

τες, also its aor. subj. act. ; aor. opt. pass. of ἀποτιμηθέντες ; pres. subj. and impf. ind. of ἦν ; aor. subj. mid. of διαπραξάμενος ; fut. opt. of ἐδύνατο.

Where is ληφθέντες found? How do you recognize this tense? What other words in the first sentence are in the same tense? What part of speech is ὡς in ὡς βασιλέα, and what limitation is there to this use of ὡς? Parse τὰς κεφαλάς. τῶν ἐμπείρως αὐτοῦ ἐχόντων ; what is the construction of αὐτοῦ? Where is γενέσθαι found, and what is its construction? What part of speech is ἐσχάτως? What case is τοῖς Λακεδαιμονίοις, and why is it in that case? What cases does πρός govern? What tense is παρέμενεν? From what verb is it? Why is the second syllable ε? Why is the ν at the end? What tense is ἐγενετο? From what verb is it? What sort of a clause is ὡς οἱ Θρᾷκες ἀδικοῦσι τοὺς Ἕλληνας? What voice is διαπραξάμενος? What is the force of a middle voice? What cases does παρά govern? Parse ἐξέπλει. What is the force of the participle πολεμήσων? Parse Θρᾴξίν. Where is ἐπειρῶντο found? What is the uncontracted form? Parse ἐθανατώθη. How do you express the agent with a verb in the passive voice? ὁποίοις λόγοις ἔπεισε Κῦρον: what is the case of λόγοις, and what does the case denote? What tense is ἐτράπετο? What is it from? Give the uncontracted form of ἐπολέμει. What is the force of ἀπό in ἀπὸ τούτων τῶν χρημάτων συλλέξας στράτευμα? Where is ἀπῆλθεν found? What is its present? Why is the second vowel η?

HOMER.

Τὸν δ' Ἑλένη μίνθοισιν ἀμείβετο, δῖα γυναικῶν.
αἰδοῖός τέ μοί ἐσσι, φίλε ἑκυρὲ, δεινός τε·
ὡς ὄφελεν θάνατός μοι ἀδεὶν κακός, ὁππότε δεῦρο
νίεϊ σῷ ἑπόμην, θάλαμον γνωτούς τε λιποῦσα
παῖδά τε τηλυγέτην καὶ ὁμηλικίην ἐρατεινήν.
ἀλλὰ τά γ' οὐκ ἐγένοντο· τὸ καὶ κλαίουσα τέτηκα.
τοῦτο δέ τοι ἐρέω, ὅ μ' ἀνείρεαι ἠδὲ μεταλλᾷς.
οὗτός γ' Ἀτρεΐδης, εὐρὺ κρείων Ἀγαμέμνων,
ἀμφότερον βασιλεύς τ' ἀγαθὸς κρατερός τ' αἰχμητὴς·
δαὴρ αὖτ' ἐμὸς ἔσκε κυνώπιδος, εἴ ποτ' ἔην γε.
ὡς φατο, τὸν δ' ὁ γέρων ἠγάσσατο φώνησέν τε·

ὦ μάκαρ Ἀτρείδη, μοιρηγενές, ὀλβιόδαιμον,
ἦ ῥά νύ τοι πολλοὶ δεδμήατο κοῦροι Ἀχαιῶν.
ἤδη καὶ Φρυγίην εἰσήλυθον ἀμπελόεσσαν·
ἔνθα ἴδον πλείστους Φρύγας ἀνέρας, αἰολοπώλους,
λαοὺς Ὀτρῆος καὶ Μυγδόνος ἀντιθέοιο,
οἳ ῥα τότ' ἑστρατόωντο παρ' ὄχθας Σαγγαρίοιο·
καὶ γὰρ ἐγὼν ἐπίκουρος ἐὼν μετὰ τοῖσιν ἐλέχθην
ἤματι τῷ ὅτε τ' ἦλθον Ἀμαζόνες ἀντιάνειραι·
ἀλλ' οὐδ' οἱ τόσοι ἦσαν, ὅσοι ἑλίκωπες Ἀχαιοί.

Parse *τόν*. What case is *μύθοισιν*? Why in that case? What would it be in Attic? Parse *ἀμείβετο*. What Homeric peculiarity in its form? Parse *αἰδοῖός τέ μοί ἐσσι*: why so accented? Where is *ἐσσί* found? Give the Attic form of it. What is *ἀδεῖν* from, and where is it found? What is the Attic form of *ὀππότε*? What is the nominative of *υἷϊ*, and why is it in the dative? Give the pres. and aor. of *ἐπόμην*. What is its Attic form? Decline *παῖδα*. What tense is *τέτηκα*, and what is it from? What is *ἀνείρεαι* from, and where is it found? Explain its termination. What part of speech is *ἀμφότερον*? What would *ἔσκε* be in Attic? What is the force of this termination, and to what tenses is it appended? What is *ἠγάσσατο* from? Why is the *σ* doubled? Give the nominative of *ὀλβιόδαιμον*. What is *δεδμήατο* from? Explain the peculiarity of its termination. Give the Attic for *εἰσήλυθον*. What is *Φρυγίην*, and why is it in that case? Nominative of *ἀμπελόεσσαν*? Is *μετὰ τοῖσιν* an Attic construction? Parse *ἤματι*: what would be in Attic? Give the Homeric declension of *ἐγώ*. What is Homer's peculiarity in treatment of the augment?

SIGHT READING.

Ἠνίκα δ'ἦν ἀμφι μεσας νύκτας, παρῆν Σεύθης ἔχων τοὺς ἱππέας τεθωρακισμένους καὶ τοὺς πελταστὰς σὺν τοῖς ὁπλοις. Καὶ ἐπεὶ παρέδωκε τοὺς ἡγεμόνας, οἱ μὲν ὁπλῖται ἠγοῦντο, οἱ δὲ πελτασταὶ εἵποντο οἱ δὲ ἱππεῖς ὠπισθοφυλάκουν. Ἐπει δ ἡμερα ἦν, ὁ Σευθης παρηλαυνεν εἰς το προσθεν και ἐπῃνεσε τον Ἑλληνικον νομον.

Write the last sentence with the accents.

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Harry Smuller Meily, C.E., Middletown, Pa.
Henry Benjamin Charles Nitze, B.S., Post Graduate, Lehigh University, South Bethlehem, Pa.
George Francis Pettinos, M.E., Bethlehem Iron Co., Bethlehem, Pa.
Robert Henry Philips, C.E., Washington, D.C.

* Deceased.

Rufus King Polk, E.M., Columbia, Tenn.
Charles Pope Pollak, C.E., St. Louis, Mo.
Mason Delano Pratt, C.E., Phœnix Bridge Co., Phœnixville, Pa.
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John Warwick Scull, M.E., Philadelphia, Pa.
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Elmer Ellis Snyder, C.E., Bethlehem, Pa.
Harry Harkness Stock, B.S., Lehigh University, South Bethlehem, Pa.
Otway Owen Terrell, M.E., Merchant Mill, Pennsylvania Steel Co., Steelton, Pa.
Edward Power Van Kirk, E.M., Johns Hopkins University, Baltimore, Md.
August J. Wiechardt, M.E., Philadelphia, Pa.
Henry August Julius Wilkens, B.S., Lehigh University, South Bethlehem, Pa.
Frank Williams, B.S., Post Graduate, Lehigh University, South Bethlehem, Pa.
Nissley Joseph Witmer, C.E., Lehigh Valley R. R. Co., Wilkes-Barre, Pa.
[W] Hampton Woods, B.S., Post Graduate, Lehigh Unisity, South Bethlehem, Pa.
Charles F. Zimmele, B.Ph., Bethlehem, Pa.

The number of Graduates is 252, of whom there are 23 who have taken the Degree of B.A.; 7 of B.Ph.; 99 of C.E.; 51 of M.E.; 24 of E.M.; 25 of A.C.; 13 of B.M.; 8 of B.S.; 2 who have taken the two degrees of A.C. and E.M.; 1 who has taken both B.S. and C.E.; 5 who have taken B.M. and E.M.; 1 who has taken C.E. and E.M.; and 1 who has taken B.M., A.C., and E.M.

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Report of the Chief Signal Officer. Parts 1 and 2. 1885.
Monthly Weather Review.

From the U. S. Navy Department.

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Nautical Almanac for 1889–90.

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Statement of Appropriations and Expenditures for Public Works.

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From the Smithsonian Institution, Washington, D. C.

Smithsonian Miscellaneous Collection. Vols. 28–30. 3 Vols.

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25th Annual Report of the Michigan Board of Agriculture.

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From Jenkin Reese, Scranton.

Petrified trunk of a tree.

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The Lehigh University

1888.

The Lehigh University,

South Bethlehem, Pennsylvania.

You are cordially invited

to be present at our celebration

of Founder's Day,

on Thursday, October 11th at 11 o'clock A. M.

An address will be delivered by

The Hon. John C. Bullitt, of Philadelphia.

R. A. Lamberton,

President.

REGISTER

OF

THE LEHIGH UNIVERSITY,

SOUTH BETHLEHEM, PA.,

1888-1889.

FOUNDED BY ASA PACKER.

TUITION FREE.

BETHLEHEM, PA.
THE COMENIUS PRESS.
1889.

TABULAR ALMANAC.

1888.

JULY.

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MAY.

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11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31
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JUNE.

S	M	T	W	T	F	S
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CALENDAR.

1888-1889.

1888. Sept. 10, 11, 12,	Monday, Tuesday and Wednesday,	Examinations for Admission.
Sept. 12,	Wednesday,	First Term begins.
Oct. 11,	Thursday,	Founder's Day.
Nov. 29,	Thursday,	Thanksgiving Day.
Dec. 19,	Wednesday,	First Term ends.
1889. Jan. 8, 9,	Tuesday and Wednesday,	Examinations for Admission to Second Term.
Jan. 9,	Wednesday,	Second Term begins.
Jan. 19,	Saturday,	Junior Prize Orations due.
Feb. 22,	Friday,	Washington's Birthday.
March 6,	Wednesday,	Ash Wednesday.
April 18,	Thursday,	Easter Holidays begin.
April 23,	Tuesday,	Easter Holidays end at 8¼ A.M.
May 27,	Monday,	University-Day Orations due.
May 29,	Wednesday,	Theses of Seniors due.
May 29,	Wednesday,	Senior Examinations begin
June 5,	Wednesday,	Annual Examinations begin.
June 8,	Saturday,	Senior Examinations end.
June 12, 13, 14,	Wednesday, Thursday and Friday,	Examinations for Admission.
June 16,	Sunday,	Baccalaureate Sermon.
June 18,	Tuesday,	Class Day.
June 19,	Wednesday,	Alumni Day.
June 20,	Thursday,	University Day.

1889-1890.

1889. Sept. 7, 9, 10,	Saturday, Monday, and Tuesday,	Examinations for Admission.
Sept. 11,	Wednesday,	First Term begins.
Oct. 10,	Thursday,	Founder's Day.
Nov. 28,	Thursday,	Thanksgiving Day.
Dec. 18,	Wednesday,	First Term ends.
1890. Jan. 7–8,	Tuesday and Wednesday,	Examinations for Admission to Second Term.
Jan. 8,	Wednesday,	Second Term begins.
June 19.	Thursday,	University Day.

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Instructor in Modern Languages.

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LIONEL R. LENOX, PH.B.,
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GEORGE M. RICHARDSON, A.C.,
Instructor in Quantitative Analysis.

SAMUEL W. FRESCOLN, C.E.,
Assistant to Professor of Civil Engineering.

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Sci.—Course in Science and Letters.
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A.C.—Analytical Chemistry.
C.E.—Civil Engineering.
E.M.—Mining Engineering.
M.E.—Mechanical Engineering.
Met.—Metallurgy.
E.E.—Electrical Engineering.

The students whose names are printed in *italics* are not clear of conditions.

GRADUATES.

	For Degree.	Residence.
Francis Joseph Crilly, B.A.,	M.A.,	Philadelphia.
William Henry Dean, A.C., E.M.,	M.S.,	Wilkes-Barre.
George Francis Duck, E.M.,	Ph.D.,	Bethlehem.
Milton Henry Fehnel, B.S.,	A.C.,	Bethlehem.
Harvey Sheafe Fisher, B.A.,	M.A.,	Pottsville.
Samuel Wilson Frescoln, C.E.,	M.S.,	Reading.
Louis Prevost Gaston, B.S.,	C.E.,	Somerville, N. J.
William Kendall Gillett, M.A.,	Ph.D.,	New York City.
John Daniel Hoffman, B.A.,	M.A.,	Bethlehem.
Robert Browne Honeyman, B.S.,	E.M.,	Bethlehem.
Preston Albert Lambert, B.A.,	M.A.,	South Bethlehem.
Elmer Henry Lawall, C.E.,	M.S.,	Audenried.
Alfred Eli Lewis, jr., B.S.,	E.M.,	Milford.
Wilson Franklin More, B.A.,	M.A.,	Catasauqua.

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George Spencer Patterson, E.M.,	M.S.,	Mahanoy City.
Albert George Rau, B.S.,	M.S.,	Bethlehem.
Joseph William Richards, A.C.,	M.S.,	Bethlehem.
George Arthur Ruddle, Ph.B.,	M.A.	E. Mauch Chunk.
Lewis Buckley Semple, B.A.,	M.A.,	Bethlehem.
Wyndham Harvey Stokes, B.S.,	E.M..	Gordonsville, Va.
William Patterson Taylor, B.A.,	M.A.,	Philadelphia.
Wade Hampton Woods, B.S.,	E.M.,	Philadelphia.

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Gustav Ayres,	M.E.,	Washington, D.C.
Ralph Putnam Barnard,	C.E.,	Washington, D. C.
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Samuel Erwin Berger,	Clas.,	Richland Centre.
Charles Hudson Boynton,	L.S.,	Washington, D.C.
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William Butterworth,	M.E.,	Cincinnati, Ohio.
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William Albert Cornelius,	M.E.,	Pittsburgh.

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John Rose Davis,	C.E.,	Phœnixville.
John William DeMoyer,	C.E.,	Duncannon.

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John Ira Riegel,	C.E.,	South Bethlehem.
Milton Holly Robbins, jr.,	M.E.,	Lakeville, Conn.
Robert Schmitz,	C.E.,	Egg Harbor City, N. J.
Anton Schneider,	C.E.,	Summit Hill.
Leidy Rudy Shellenberger,	C.E.,	Benjamin.
Ira Augustus Shimer,	Clas.,	Redington.
Charles Henry Simpson,	C.E.,	Pensacola, Fla.
Matthew Charles Smith,	C.E.,	Birmingham, Ala.
Oscar Emmerson Smith,	C.E.,	Portsmouth, Va.
Michael Druck Sohon,	A.C.,	Washington, D. C.
William Buchecker Spengler,	M.E.,	Bethlehem.
Horace Theodore Stilson,	C.E.,	Cleveland, Ohio.
Joseph William Stone,	M.E.,	New Orleans, La.
Mercer Brown Tate,	M.E.,	Harrisburg.
William Sidney Topping,	L.S.,	Sagg, N. Y.
Domingo Anthony Usina,	C.E.,	Savannah, Ga.
Michael Neligan Usina,	E.E.,	Savannah, Ga.
Elias Vander Horst,	C.E.,	Charleston, S. C.
William Alder Webb,	M.E.,	Bethlehem.
George Edward Wendle,	E.E.,	Philadelphia.
Francis Nichols Whitney,	M.E.,	Pottsville.
George Brown Zahniser,	C.E.,	Mercer.

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William North Robins Ashmead,	Clas.,	Minersville.
George William Ballock Asmussen,	C.E.,	Washington, D. C.
Herbert Burr Atha,	C.E.,	Newark, N. J.
George Haldeman Atkins,	C.E.,	Pottsville.
Hanson Entriker Atkins,	M.E.,	Pottsville.
Robert Ligget Baird,	C.E.,	Philadelphia.
Noble Banks,	C.E.,	Savannah, Ga.
Joseph Barrell,	E.M.,	New Providence, N, J.
Charles Bartles, jr.,	E.M.,	Williamsport.
John Young Bassell, jr.,	E.E.,	Leesburg, Va.
John Newbaker Bastress,	C.E.,	Sunbury.
Finus Earl Blakeney,	C.E.,	Little Rock, Ark.
Herman Renner Blickle,	C.E.,	Cincinnati, Ohio.
Samuel Branson,	M.E.,	Wrightstown, N. J.
George Jones Bridgers,	C.E.,	Wilmington, N. C.
Alfred Tennyson Brown,	E.E.,	Rising Sun, Ind.
John Emery Bucher,	A.C.,	Hanover.
Charles Merritt Case,	M.E.,	Minneapolis, Minn.
George Price Case,	M.E.,	Minneapolis, Minn.
Philip Lothrop Cobb,	C.E.,	Cleveland, Ohio.
Samuel Dewey Cushing,	E.M.,	Washington, D.C.
Heber Denman,	E.M.,	Kendall Creek, Pa.
Heber Thornton Dickerman,	C.E.,	Chapman Quarries.
Edwin Dodge,	E.M.,	Gouverneur, N. Y.
Robert Arthur Downey,	C.E.,	Oswego, N. Y.
Howard Weidener DuBois,	E.M.,	Philadelphia.

	Course.	Residence.
Philip Garrett Eastwick, jr.,	E.E,,	Portland, Oregon.
Harry Clifford Eddy,	E.E.,	Morristown, N. J.
George Washington Engle,	E.M.,	Ashland.
Edward Fargason,	M.E.,	Memphis, Tenn.
Arthur Haldeman Fetters,	M.E,	Barneston.
George Buchanan Fife,	C.E.,	Washington, D. C.
Henry Cowan Blair Finley,	E.M.,	Chattanooga, Tenn.
Ralph Stillman Garwood,	Clas.,	Bethlehem.
William Lasher Gilmore,	E.E.,	New York City, N. Y.
Thanlow Gjersten,	C.E.,	Saxton.
Samuel Morrison Graham,	M.E.,	Phillipsburg.
William Harry Goll,	C.E.,	Lancaster.
John Adams Gruver,	Clas.,	Springtown,
Cornelius Silsby Hawkins,	E.E.,	Fall River, Mass.
Edwin Paul Hazel,	M.E.,	Cressona.
Howard Bright Heller,	M.E.,	South Bethlehem.
Charles Miller Hobbs,	E.E.,	Hulmesville.
Benjamin Williams Homans,	C.E.,	Brooklyn, N. Y.
George Washington Howard, jr.,	E.E.,	Hagerstown, Md.
Hartley Howard, jr.,	E.E.,	Pittsburgh.
Rollin Germaine Hubby,	E.E.,	Cleveland, O.
Edward Blackstone Hurst,	C.E.,	Cincinnati, O.
William Lawall Jacoby,	M.E.,	South Bethlehem.
Alfred Emerson Jessup,	A.C.,	New York City, N. Y.
William Edward Johnson,	C.E.,	Glastonbury, Conn.
Arthur Bacon Jones,	E.M.,	Sewickley.
John Elmer Jones,	E.M.,	Hazleton.
Charles Lincoln Keller,	M.E.,	Dubuque, Iowa.
Henry Whitman Kern,	M.E.,	Chicago, Ill.
Robert Reed Kitchel,	M.E.,	South Bethlehem.
William Heath Kramer,	Clas.,	New Iberia, La.
Sylvester Welch Labrot,	C.E.,	Frankfort, Ky.

	Course.	Residence.
Herbert Gilfillan Lamberton,	C.E.,	Franklin.
Robert William Lawder,	E.M.,	Mexico, Mo.
George Edwin Lefevre,	A.C.,	Panama, U.S.Colombia.
Ellis Lewis,	A.C.,	Washington, D. C.
Alfred Emory Lister,	M.E.,	Carbondale.
William John Lloyd,	E.E.,	Philadelphia.
John Taylor Loomis,	E.E.,	Philadelphia.
Owen Francis Luckenbach,	M.E.,	Bethlehem.
George Hillard Lynch,	C.E.,	Wilkes-Barre.
James Alvan Macauley,	C.E.,	Washington, D. C.
William Ellicott Maccoun,	M.E.,	Baltimore, Md.
Henry Lewis Manley,	E.M.,	Ashland.
Edward Richard Martin,	C.E.,	Seaford, Del.
Raymond Masson,	E.E.,	Hammondsport, N. Y.
Archibald Stewart Maurice,	C.E.,	Athens.
Charles Watson Meade,	Clas.,	Cumberland, Md.
Victoriano Mendozo,	C.E.,	Gaudalajara, Mex.
Frank Anderson Merrick,	E.E.,	New Hope.
Edward James Millar,	C.E.,	West Broome, P.O., Can
Frederick Kent Morris,	Sci.,	Moorestown, N. J.
Charles Tyler Mosman,	E.E.,	Washington, D. C.
Frank Hamilton McCall,	M.E.,	Binghamton, N. Y.
Mathew McClung, jr.,	C.E.,	Knoxville, Tenn.
Joseph Ezekiel McDonald,	C.E.,	Washington, D. C.
John Cox McKean,	Sci.,	South Bethlehem.
Harvey Frankenfield Nase,	C.E.,	Springtown.
Robert Blum Olney,	C.E.,	Charleston, S. C.
Henry Orth, jr.,	E.M.,	Washington, D. C.
Ramon Eckhart Ozias,	C.E.,	Quakertown.
John Paret, jr.,	E.E.,	New York, N. Y.
William Taylor Patterson,	E.E.,	Mahanoy City.
Frank Everett Pratt,	C.E.,	Nicholson.

	Course.	Residence.
Joaquin Prieto,	M.E.,	Bogota, U. S. Colombia.
Thomas Clement Rafferty,	M.E.,	Chicago, Ill.
Enrique Alejandro Ramsden,	C.E.,	Santiago de Cuba.
Frank De Witt Randolph,	M.E.,	Plainfield, N. J.
Robert Swenk Rathbun,	C.E.,	Allentown.
Edgar Randolph Reets,	A.C.,	Wilkes-Barre.
Samuel Arthur Rhoads,	A.C.,	Birdsboro.
George William Ritchey.	L.S.,	Pittsburgh.
Edwin Gray Rust,	M.E.,	Leesburgh, Va.
Frank Schutte,	A.C.,	Philadelphia.
William Frederick Semper,	A.C.,	Philadelphia.
John Bonner Semple,	E.E.,	Pittsburgh.
Edward Hagan Shaw,	M.E.,	Philadelphia.
Cass Knight Shelby,	M.E.,	Grand Rapids, Mich.
Carroll Bradford Smith,	E.E.,	Norristown.
Clarence Galen Smith,	A.C.,	Cleveland, O.
Philip Henry Smith,	E.E.,	Parsippany, N. J.
Robert Jones Snyder,	M.E.,	Bethlehem.
Thomas George Spear,	C.E.,	Camden, N. J.
John Stewart,	E.M.,	Lonaconing, Md.
Frederick Elam Summers,	C.E.,	Washington, D. C.
Wilson Jones Taylor,	C.E.,	Edgmont.
Thomas Cedwyn Thomas,	C.E.,	Wilkes-Barre.
John Harry Tonkin,	C.E.,	Wilkes-Barre.
Lester Warren Walker,	E.E.,	North Platte, Neb.
Walker Wynne Wentworth,	E.E.,	Slatington.
Frank Parish Wilson,	E.M.,	Plainfield, N. J.
David Hykes Witmer,	C.E.,	Annville.
Frederic Wittman,	A.C.,	Lanark.
Charles Oaks Wood,	M.E.,	Chambersburg.
Byron Edgar Woodcock,	E.E.,	Altoona.

SPECIAL STUDENTS.

	Course.	Residence.
William Alexander Auchinvole,	A.C.,	Harrisburg.
Allen Harwood Babcock,	A.C.,	Oakland, Cal.
William Young Brady,	C.E.,	Franklin.
Albert Brodhead,	A.C.,	Bethlehem.
Charles Joseph Coll.	C.E.,	Broad Ford.
George Patterson Dravo, M.E.,	Met.,	Allegheny.
George Edmund Gay,	E.M.,	Pottsville.
Albert Edward Juhler,	A.C.,	Pomeroy, Ohio.
Harry Kinzer Landis,	E.M.,	Landis Valley.
Charles Douglass Mather,	M.E.,	Kincardine, Ont., Can.
Charles Wiltberger Platt,	A.C.,	New York, N. Y.
Alexander Potter,	C.E.,	Halifax, N. S.
Frank R. Reynolds,	A.C.,	Marietta, Ga.
Louis Augustus Round,	M.E.,	Providence, R. I.
Albert B. Rupp,	C.E.,	Mechanicsburg.
James Edward Strong,	E.M.,	England.
Samuel Dexter Warriner,	E.M.,	Montrose.
Frank Shriver West,	A.C.,	Philadelphia.
Edward Adam Wilhelm,	M.E.,	East Toledo. O.
Walter S. Winn,	C.E.,	Winchester, Ky.
Robert Jacob Yost,	A.C.,	South Bethlehem.
Roger Hanson Zimmerman,	E.M.,	Louisville, Ky.

SUMMARY OF STUDENTS BY STATES.

Vermont,	1
Massachusetts,	4
Connecticut,	3
Rhode Island,	3
New York,	30
Pennsylvania,	199
New Jersey,	23
Delaware,	1
Maryland,	9
District of Columbia,	24
Virginia,	4
West Virginia,	2
North Carolina,	2
South Carolina,	4
Georgia,	6
Alabama,	1
Florida,	1
Louisiana,	2
Ohio,	12
Indiana,	3
Illinois,	5
Arkansas,	1
Wisconsin,	1
Minnesota,	2
Michigan,	1
Iowa,	1
Missouri,	3
Kentucky,	4
Tennessee,	3
Kansas,	1

Colorado,	2
California,	1
Oregon,	2
Nebraska,	2
Mexico,	1
New Mexico,	1
Nicaragua,	1
Nova Scotia,	1
Porto Rico,	1
Cuba,	4
Jamaica,	1
England,	1
Greece,	1
United States of Colombia,	4
Germany,	1
Canada,	2
Total,	383

SUMMARY OF STUDENTS BY CLASSES.

Graduates,	22
Seniors,	59
Juniors,	59
Sophomores,	99
Freshmen,	122
Specials,	22
Total,	383

SUMMARY OF STUDENTS BY COURSES.

SCHOOL OF GENERAL LITERATURE.

Classical Course,	22	
Latin-Scientific Course,	4	
Course in Science and Letters,	5	
		31

SCHOOL OF TECHNOLOGY.

Course in Civil Engineering,	124	
Course in Mechanical Engineering,	81	
Course in Mining Engineering,	61	
Course in Electrical Engineering,	41	
Course in Analytical Chemistry,	45	
		352
Total,		383

THE LEHIGH UNIVERSITY.

ORIGIN.

The Hon. ASA PACKER, of Mauch Chunk, during the year 1865, appropriated the sum of Five Hundred Thousand Dollars, to which he added one hundred and fifteen acres of land in South Bethlehem, to establish an educational Institution in the rich and beautiful Valley of the Lehigh. From this Foundation rose THE LEHIGH UNIVERSITY, incorporated by the Legislature of Pennsylvania in 1866. In addition to these gifts, made during his life-time, Judge Packer by his last will secured to the University an endowment of $1,500,000, and to the University Library one of $500,000.

DESIGN.

The original object of Judge Packer was to afford the young men of the Lehigh Valley a complete education, technical, literary and scientific for those professions represented in the development of the peculiar resources of the surrounding region. In furtherance of this purpose instruction is liberally provided in Civil, Mechanical, Mining and Electrical Engineering, Chemistry, Metallurgy, and in all needful collateral studies. A School of General Literature is also established and thoroughly equipped, with three departments called respectively, the Classical, the Latin-Scientific, and that of Science and Letters. These departments are kept up to the standard, and the requirement for entrance is the same as those of our best Classical and Literary institutions. A course in Architecture has also been ordered.

FREE TUITION.

All these educational facilities are provided without charge. Through the generosity of the Founder, the Trustees were enabled, in 1871, to declare tuition FREE in all branches and classes. The Lehigh University is open to young men of good character and suitable preparation from every part of our own land and of the world. To this fact the attention of the pupils of our public schools and of the graduates of classical institutions is especially called. Thus is offered, *without charge*, every facility for studying the professions of the Civil, Mechanical, Mining and Electrical Engineer, and of the Metallurgist and Analytical Chemist. In the Classical and Scientific departments of the School of General Literature instruction is given in the Classics, Sciences and Letters.

PUBLIC WORSHIP.

Prayers are held in the Packer Memorial Church of the University every morning and all students are required to be present.

Divine Service is held on every Sunday morning in the Church. The service is according to the forms of the Protestant Episcopal Church, under whose auspices the University was placed by its Founder. Attendance is required of every student, except in case of those connected with other religious bodies, to whom the President will grant permission at the beginning of each term (if requested by the parent or guardian, or by the student himself if he be 21 years of age) to attend during that term the place of worship of the body with which he is connected, where attendance on Sunday morning will be required.

SITE.

The situation of the Institution is healthful and beautiful. The region is famous for its railway and manufacturing enterprises; it possesses some of the richest iron and coal mines in our land, and thus gives the students rare facilities for confirming the teachings of the recitation room by the observation of the eye.

The University Buildings are about a half-mile from the depot, at the junction of the Lehigh Valley and North Pennsylvania Railroads. New York is ninety-two, and Philadelphia fifty-four miles distant.

BUILDINGS.

PACKER HALL,

named after the Founder, stands seven hundred feet back of Packer Avenue, at the base of the South Mountain. It is built of stone, and contains Lecture and Recitation Rooms, the Drawing Rooms and the Museum of Geology and Natural History.

THE CHEMICAL LABORATORY

is thoroughly fire-proof, is built of sandstone, and is 219 feet in length by 44 in width.

There are two principal stories and a basement. The upper floor is occupied by the quantitative and the qualitative chemical laboratories, the former accommodating 48 and the latter 84 students. These rooms are 20 feet in height, and are well lighted and ventilated. A laboratory for industrial chemistry and the supply room are also on this floor.

The first floor contains a large lecture room, a recitation room, a chemical museum and laboratories for organic, physiological, agricultural and sanitary Chemistry.

In the basement is the large laboratory for the furnace assay of ores and a well appointed laboratory for gas analysis, also rooms containing the apparatus for several processes in industrial chemistry, the engine and air-pump for vacuum filtration, a store room and the toilet.

A photographic laboratory is located in the third story of the central portion of the building.

THE METALLURGICAL LABORATORY

contains a lecture room, a blowpipe laboratory for class instruction in blowpipe analysis and in the practical determination of crystals and minerals, a museum for mineralogical and metallurgical collections, a mineralogical laboratory

provided with a Fuess reflecting goniometer, a polariscope, a Groth's "universal apparat" and a Rosenbusch polarizing microscope, a dry laboratory provided with furnaces for solid fuel and for gas with natural draught and with blast, and a wet laboratory for ordinary analytical work. It is arranged for the instruction of classes in the courses of mineralogy, metallurgy and blowpipe analysis of the regular curriculum, and to afford facilities to a limited number of advanced students to familiarize themselves with the methods of measurement and research employed in mineralogy and metallurgy, and to conduct original investigations in these departments of science.

THE PHYSICAL LABORATORY

consists of three stories. A large lecture room with a seating capacity of 150, occupies a portion of the second and third floors. It is well lighted and adapted to its purposes. On the remainder of these floors are two rooms, each 40 feet long, for Heat and Light laboratories, a dark room for photographic work, spectroscopic and apparatus rooms and the private laboratories of the Instructors.

The lower floor is devoted to the use of the students in Electricity. A large room nearly 40 feet square is used as the Electrical Laboratory. There are smaller rooms for photometric and spectroscopic work, also reading, balance, apparatus and engine rooms. On this floor a 12 horse-power high speed engine and a dynamo supply two systems of electric lights, one of 25 incandescent lamps, the other of four arc lights, for practical tests in the Electrical Laboratory and for experimental purposes in the lecture room above. In the cellar are battery, store rooms, etc.

The tower and two rooms in the east end of Christmas Hall have been given to the Department of Physics and will be equipped as a Meteorological Observatory.

THE SAYRE OBSERVATORY.

Near Brodhead Avenue is the Sayre Observatory, the gift of Robert H. Sayre, Esq., of South Bethlehem, containing an equatorial and a zenith telescope, transit instrument and astronomical clock.

THE UNIVERSITY LIBRARY.

To the east of Packer Hall is the University Library, erected by the Founder in memory of Mrs. Lucy Packer Linderman, his daughter.

THE GYMNASIUM

is a handsome and spacious structure, built and equipped with the utmost thoroughness. It is furnished with the best patterns of gymnastic apparatus, besides Dr. Sargent's system of Developing Appliances. It is provided with hot and cold water; tub, sponge and shower baths, and 389 clothes closets. Opportunities for recreation and amusement are provided in the billiard room and bowling alleys. It is under the immediate care of a skilled and competent Director.

All students are required to undergo a physical examination before being allowed the use of the Gymnasium, and this examination will be repeated once each year during their stay at the University. The proper exercise is prescribed and is required of every student. The aim of the Institution is to promote a harmonious symmetrical development best suited to the individual condition of the student.

EXPENSES.

Tuition is FREE in all branches and classes. Books, materials, paper, pencils, chemical materials used in the analytical laboratory and drawing instruments, are furnished by the student.

Rooms and Board can not be had in University buildings, but can readily be obtained in many private houses.

The following is an estimate of the necessary expenses for the collegiate year, clothing and traveling not included:

Board for 40 weeks, . . .	from $160 to $200
Room-rent, with fuel and lights .	40 " 80
Care of room and use of furniture,	5 " 20
Washing and incidentals, . . .	20 " 40
Books, stationery, etc., . . .	25 " 50
Total, ...	$250 to $390

NOTE.—If clubs be formed the cost of board need not exceed $3.50 per week.

ADMISSION OF STUDENTS.

Application should be made to the President of the University, for all information concerning the admission of students. The Register is intended to give what is necessary.

DATE OF EXAMINATIONS.

Examinations for admission to the University are held at the opening of each term, and also in June at the close of the Academic year.

The examinations for 1889 will be on Tuesday and Wednesday, January 8 and 9, for admission to the *second term;* on Wednesday, Thursday and Friday, June 12, 13 and 14, and on Saturday, Monday, and Tuesday September 7, 9 and 10, for admission to the first term. No other examinations for entrance will be held, except for good cause, and all applicants *must* be in attendance at 8.30 on the morning of the first day.

The examinations are held in the following order:

First Day.—English Grammar, 9.00 A.M.; Geography, 11.30 A.M.; United States History, 2 P.M.; Physical Geography, 4 P.M.

Second Day.—Geometry, 9 A.M.; Arithmetic, 2 P.M.; Algebra, 3.30 P.M.

Third Day.—Latin and Roman History; Elementary Physics, 8.30 A.M.; Greek and Greek History, 2 P.M.

CHARACTER OF THE EXAMINATIONS.

The examinations are rigorous and cover the entire ground laid down in the following scheme. They are all conducted in writing, supplemented by an oral examination at the option of the examiner.

All candidates for admission must be at least sixteen years of age, must present testimonials of good moral

character from their last Instructor, or from the School or Institute to which they last belonged, or from some reputable citizen of the community in which they live and, must satisfactorily pass in the following subjects:

1. *English Grammar*, including composition, spelling and punctuation. It is recommended that candidates have a knowledge of Latin Grammar, although an examination in it is not required for any courses except the Classical and the Latin-Scientific.

2. *Geography*, general and political.

3. *History of the United States*, including the *Constitution*.

4. *Arithmetic*, including the metric system of weights and measures.

5. *Algebra*, Fundamental Principles. Factoring. Least Common Multiple. Greatest Common Divisor. Fractions. Involution. Evolution. Radicals. Imaginary Quantities. Equations of the First and Second Degrees. Ratio. Proportion and Progressions.

[Olney's University Algebra is recommended, as it is the text-book used in the University.]

6. *Geometry*, Fundamental Principles. Rectilinear Figures. The Circle. Proportional Lines and Similar Figures. Comparison and Measurement of the Surfaces of Rectilinear Figures.

[Chauvenet's Geometry, (four books) is recommended, as it is the text-book used in the University.]

For admission to the various courses, *in addition* to the requirements above given, the examinations are as follows:

For all Courses except the Classical.

7. *Geometry*, Regular Polygons, Measurement of the Circle, Maxima and Minima of Plane Figures, and Plane and Polyhedral Angles; these constituting the subject matter of Books Five and Six of Chauvenet's Geometry.

8. *Elementary Physics.*

[Avery's Elements of Natural Philosophy (revised edition) is recommended.]

For the Latin-Scientific and Classical Courses.

9. *Physical Geography.*

10. *Latin Grammar*, (Harkness' preferred).

11. *Cæsar*, four books of the Gallic war.

12. *Cicero*, six orations, including the four against Catiline.

13. *Virgil*, the first six books of the Aeneid, including Prosody.

14. The translation, at sight, of passages from Cæsar and Cicero.

15. The translation of English into Latin. (As special importance is given this part of the examination, it is suggested to teachers that they connect exercises in making Latin, both oral and written, with all the studies of the preparatory course.)

16. *Roman History.* Creighton's Primer of Roman History is suggested as indicating the amount required.

For the Classical Course only.

17. *Greek Grammar*, (Hadley-Allen preferred).

18. *Xenophon*, Anabasis, four books.

19. *Homer*, Iliad, three books, including Prosody.

20. The translation, at sight, of a passage from some work of Xenophon.

21. *Greek History.* Fyffe's Primer of Greek History is suggested.

22. Writing Greek with accents.

The pronunciation of Greek according to the written accents is followed in the University, and it is desirable that students preparing to enter be taught this system.

Division of Entrance Examinations.

Candidates for admission to the Freshman Class may pass all the examinations *at once* in June, or in September, or may take them in *two consecutive years.* In the latter case for the Technical courses and the course in Science and Letters, candidates may present themselves for examination in the first year in the following subjects: English

Grammar, Geography, History of the United States, and Arithmetic. No credit will be given unless the candidate has passed satisfactorily in at least three subjects at one examination.

The examinations in Algebra, Geometry and Physics must be passed in June or September of that year in which the candidate proposes to enter the University.

In the Latin-Scientific and Classical courses candidates may present themselves for examination in the first year in the following subjects: English Grammar, History of the United States, Arithmetic, Physical Geography, and Roman History. No credit will be given unless the candidate has passed at least four of the subjects at one examination.

The examination in Latin may also be divided, but no credit will be given unless the candidate has passed in at least three of the topics specified at one examination. The examination in the remaining subjects must be passed in June or September of that year in which the candidate proposes to enter the University.

Candidates intending to enter the University in September are advised to present themselves for examination in June; if they are not fully prepared at that time they will receive credit for the examinations then satisfactorily passed.

CONDITIONAL ADMISSION.

A candidate failing to pass in one or more of the subjects required for admission may, at the discretion of the Faculty, be admitted to his class conditionally, to make up his deficiencies by extra study. When they are made up, he will be received into full standing in his class.

SPECIAL STUDENTS.

Young men who do not desire to take a full regular course can enter and select special shorter courses, with the sanction of the Faculty; but in all cases satisfactory examinations must be passed upon the subjects required for admission to the Freshman class.

ADMISSION TO ADVANCED STUDIES.

Candidates for admission to advanced studies *in any course* are required to pass, *in addition to the entrance examinations for that course*, examinations in the work already done by the classes which they desire to enter. These examinations are held on the same days as those for admission to the Freshman class.

The additional subjects may be found in the program of studies.

A diploma or, in so far as it covers the subjects required for admission, a certificate of studies taken at another College will be received in lieu of the *Primary Entrance Examinations only*.

ADMISSION TO THE POST GRADUATE COURSE.

Students of this University who have taken their *first* degree, and others, on presenting a diploma of an equivalent degree conferred elsewhere, are admitted to advanced studies, according to the plan to be found under the general subject of Graduate Students.

PREPARATORY SCHOOL CERTIFICATES

are not accepted so as to dispense with the primary entrance examination.

NOTE.—The acceptance of a certificate as evidence of proficiency in lieu of examination, is at the discretion of each Professor as to the subjects in his department.

PROGRAM OF STUDIES,

Showing the number of exercises per week for each subject, and the Text-books used.

The following is presented as the general program of instruction, subject to such modifications from time to time as the Faculty may deem expedient, with the approval of the Trustees.

The names of the text-books studied are generally mentioned. The number of exercises per week in each subject is indicated by the figure in parentheses immediately following.

Two hours of Drawing, three of work in the Laboratory, or three of practice in the field, are regarded as equivalent to a recitation or lecture of one hour's duration.

SCHOOL OF GENERAL LITERATURE.

This school is intended to correspond to the course long established in our older colleges, modified by the needs and requirements of modern culture. Its object is to impart a comprehensive and liberal education to those who design to enter upon professional rather than technical pursuits.

It comprises three distinct courses:

I.—The Classical Course or Course in Arts.

II.—The Latin-Scientific Course or Course in Philosophy.

III.—The Course in Science and Letters.

THE CLASSICAL COURSE.

This course is chiefly designed for those who purpose to study Law and Theology; it includes full and rigorous instruction in the Ancient Classics, in Elementary Science and in General Literature. The study of Mathematics in this course embraces Algebra, Geometry, Trigonometry, Analytical Geometry, and the Calculus. The program

includes Physics, Chemistry and Elementary Mechanics. There are full courses in History, in the Science of Language and on the origin and growth of the English Language. There are also lectures on Psychology, Christian Evidences, International and Constitutional Law and Political Economy. Lectures on English Literature are supplemented by critical readings of the standard English authors. The graduate in this course obtains the degree of Bachelor of Arts (B.A.).

FRESHMAN CLASS.

FIRST TERM.

Mathematics.—Geometry (Chauvenet). (4)
Chemistry.—Lectures. Fownes' Elementary Chemistry. (4)
Greek.—Homer: Odyssey. Prosody. (3)
Latin.—Livy. Prose Composition. (2)
History.—History of Greece. (1)
Physiology and Health.—Lectures. (1)
English.—Exercises and Declamations. (1)
Gymnasium. (2)

SECOND TERM.

Mathematics.—Olney's University Algebra, Pt. III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic tables. (2)
Greek.—Xenophon: Oeconomicus. (3)
Latin.—Cicero: De Amicitia. Horace: Odes and Epodes. Composition and Prosody. (4)
History.—History of Greece. (2) History of Rome. (1)
English.—Exercises and Declamations. (1)
Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry. Olney's General Geometry. (4)
Physics.—Lectures. (3)
French.—Whitney's Practical French Grammar. Keetel's

Analytical Reader. (2) Or *German.*—Brandt's Grammar. Lodeman's Manual of Exercises. Joynes' Otto's Reader. (2)

Greek.—Herodotus. (2)

Latin.—Tacitus: Agricola and Germania. Composition. (2)

History.—History of Rome. (2)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

**Mathematics.*— Differential and Integral Calculus: Olney. (4)

French.—Grammar and Reader (continued). (2) Or *German.*—Grammar, Exercises and Reader (continued). (2)

English.—Coppée's Rhetoric, with Kellogg's Praxis. (1)

History.—Weber's Outlines of Universal History. (2)

Greek.—Euripides: Medea. (3)

Latin.—Quintilian: Book X. Horace: Satires and Epistles. Composition. (3)

Essays and Declamations. (1)

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

History.—Wilhelm Müller's Political History of Recent Times, and Lectures. (2)

Philosophy.—Coppée's Logic (2)

English.—Coppée's English Literature. (4)

French.—Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

Greek.—Sophocles: Electra. Antiquities. (3)

Latin.—Plautus and Terence. Roman Antiquities: Wilkins. (3)

Literature and History. (1)

Gymnasium. (2)

* After the present year, Elective Courses in English, Greek, Latin, and other studies will be offered for those classical students who do not wish to pursue the study of the Calculus.

SECOND TERM.

History.—History of England: Hume. (3)

Philosophy.—Hill's Psychology. (2) Political Economy. (1)

English.—Earle's Philology of the English Tongue. (2)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Gasc's Translator. Dictation. (2) Or *German.*—Grammar. Reading. Dictation. (2)

Greek.—Aristophanes: Clouds. (3)

Latin. - Juvenal and Persius. Pliny: Select Epistles. Cruttwell's History of Roman Literature. (3)

Essays and Original Orations. (1)

Gymnasium. (2)

SENIOR CLASS.

FISRT TERM.

International Law.—Lectures: Woolsey. (2)

History.—Decline and Fall of the Roman Empire: Gibbon. (3)

Philosophy.—Haven's Moral Philosophy. (2)

Astronomy.—Loomis' Treatise, with Lectures. (3)

French.—Grammar. Saintsbury: Specimens of French Literature. Readings in Corneille, Racine, Molière, etc., and Contemporary authors. Compositions. Lectures on French Literature. (2) Or *German.*—Grammar. Readings in Lessing, Herder, Goethe, Schiller, etc., and Contemporary Authors. Compositions. Lectures on German Literature. (2)

Conversation Class in both languages optional throughout the year.

Greek.—Pindar: Selected Odes. Greek Literature. (2)

Latin.—Lucretius, with Lectures. Roman Literature. (2)

Essays and Original Orations. (1)

Gymnasium. (2)

SECOND TERM.

Constitutional Law.—Lectures. (1)

History.—History of France. (2)

Philosophy.—History of Philosophy. (1) Philosophy of History. Lectures. (2)

Christian Evidences. (1)

French.—Readings. Compositions. Lectures in French on Modern French Authors. (2) Or *German.*—Readings. Compositions. Lectures in German on Modern German Authors. (2)

Geology.—Lectures. Geikie. (2)

Greek.—Thucydides. Greek Literature completed. (2)

Latin.—Catullus, Tibullus and Propertius. Cicero: de Officiis, with Lectures. Roman Literature (completed). (2)

Lectures on American and English Literature. (2)

Preparation of Thesis.

Gymnasium.

THE LATIN-SCIENTIFIC COURSE.

The Latin-Scientific Course leading to the degree of Bachelor of Science (B.S.) is based on Latin without Greek.

FRESHMAN CLASS.

FIRST TERM.

Mathematics.—Geometry (Chauvenet completed). (4)

Chemistry.—Lectures. Fownes' Elementary Chemistry. (4)

German.—Joynes-Meissner's Grammar. Joynes-Otto's Reader. (3)

Latin.—Livy. Prose Composition. (2)

History.—History of Greece. (1)

Physiology and Health.—Lectures. (1)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of the Logarithmic Tables. (2)

German.—Grammar. Reader (continued). (3)

History.—History of Greece. (2) History of Rome. (1)

Latin.—Cicero: De Amicitia. Horace: Odes and Epodes. Composition and Prosody. (4)
English.—Exercises and Declamations. (1)
Gymnasium. (2.)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4.)
Physics.—Lectures. (3)
French.—Whitney's Practical French Grammar. Keetel's Analytical Reader. (2)
German.—Grammar. Reading. (2)
History.—History of Rome. (2)
Latin.—Tacitus: Agricola and Germania. Composition. (2)
English.—Exercises and Declamations. (1)
Gymnasium. (2)

SECOND TERM.

Mathematics. — Differential and Integral Calculus: Olney. (4)
English.—Coppée's Rhetoric, with Kellogg's Praxis. (1)
French.—Grammar. Reader (continued). (2)
German.—Grammar. Reading. Dictation. (2)
History.—Weber's Outlines of Universal History. (2)
Latin. — Quintilian: Book X. Horace: Satires and Epistles. Composition. (3)
Essays and Declamations. (1)
Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

History.—Wilhelm Müller's Political History of Recent Times, and Lectures. (2)
Philosophy.—Coppée's Logic. (2)

English.—Coppée's English Literature. (4)

French.—Grammar. Reading. (2)

German.—Readings in Lessing, Herder, Goethe, Schiller and Contemporary Authors. Dictation. Compositions. (2)

Conversation Class in German optional throughout the year.

Latin. – Plautus and Terence. Roman Antiquities: Wilkins. (3)

Literature and History. (1)

Gymnasium. (2)

SECOND TERM.

History.—History of England: Hume. (3)

Philosophy. — Hill's Psychology. (2) Political Economy. (1)

English. — Earle's Philology of the English Tongue. (2)

French. —Grammar. O'Connor: Choix de Contes Contemporains. Gasc's Translator. Dictation. (2)

German. —Readings (continued). Dictation. Compositions. (2)

Latin. – Juvenal and Persius. Pliny: Select Epistles. Cruttwell's History of Roman Literature. (3)

Essays and Original Orations. (1)

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

International Law.—Lectures: Woolsey. (2)

History. — Decline and Fall of the Roman Empire: Gibbon. (3)

Philosophy.—Haven's Moral Philosophy. (2)

Astronomy.—Loomis' Treatise, with Lectures. (3)

French. – Saintsbury: Specimens of French Literature. Readings in Corneille, Racine, Molière, etc., and Contemporary authors. Lectures on French Literature. (2)

German.—Readings (continued). Compositions. Lectures on German Literature. (1)

Conversation Class in both languages optional throughout the year.

Latin.—Lucretius, with Lectures. Roman Literature. (2)

Essays and Original Orations. (1)

Gymnasium.

SECOND TERM.

Constitutional Law.—Lectures. (1)

History.—History of France. (2)

Philosophy.—History of Philosophy. (1) Philosophy of History. Lectures. (2)

Christian Evidences. (1)

Geology.—Lectures. Geikie. (2)

Latin.—Catullus, Tibullus and Propertius. Cicero: de Officiis, with Lectures. Roman Literature (completed). (3)

French.—Readings (continued). Compositions. Lectures in French on Modern French authors. (2)

German.—Readings (continued). Compositions. Lectures in German on Modern German authors. (1)

Lectures on American and English Literature. (2)

Preparation of Thesis.

Gymnasium.

A COURSE IN SCIENCE AND LETTERS.

The Course in Science and Letters, leading to the Degree of Bachelor of Science (B.S.), is designed for those who wish to pursue both Scientific and Literary studies without Latin and Greek. These being omitted, extended instruction is given in French and German, History, General Literature, Mathematics and General Science.

FRESHMAN CLASS.

FIRST TERM.

Mathematics.—Geometry, (Chauvenet) completed. (4)

Chemistry.—Lectures. Fownes' Elementary Chemistry. (4)

German. — Joynes-Meissner's Grammar. Joynes-Otto's Reader. (3)

Drawing.—Elementary Projections, Shading and Lettering. (2)

History.—History of Greece. (1)

Physiology and Health.—Lectures. (1)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of the Logarithmic Tables. (2)

Chemistry.—Qualitative Analysis. (3)

History.—History of Greece. (2) History of Rome. (1)

German.—Grammar. Reader (continued). (3)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)

Physics.—Mechanics, Heat and Electricity. Lectures. (5)

French.—Whitney's Practical French Grammar. Keetel's Analytical Reader. (2)

German.—Grammar. Readings. (2)

History.—History of Rome. (2)

English.—Exercises and Declamation. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics. — Differential and Integral Calculus: Olney. (4)

Physics.—Sound, Light and Meteorology. Lectures. (3)

English.—Coppée's Rhetoric, with Kellogg's Praxis. (1)

French.—Grammar. Readings (continued). (2)
German.—Grammar. Readings. Dictation. (2)
History.—Weber's Outlines of Universal History. (2)
Essays and Declamations. (1)
Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

History.—Wilhelm Müller's Political History of Recent Times, and Lecturers. (2)
Philosophy.—Coppée's Logic. (2)
English.—Coppée's English Literature. (4)
French.—Grammar. Readings. (2)
German.—Readings in Lessing, Herder, Goethe, Schiller and Contemporary authors. Dictation. Compositions. (2)
Conversation Class in German optional throughout the year.
Zoology.—Lectures and Laboratory work. Tenney. (2)
Crystallography.—Lectures, with Practical Exercises in the determination of Crystals. (2)
Literature and History. (1)
Gymnasium. (2)

SECOND TERM.

History.—History of England: Hume. (3)
Philosophy.—Hill's Psychology. (2) Political Economy. (1)
English.—Earle's Philology of the English Tongue. (2)
French.—Grammar. O'Connor: Choix de Contes Contemporains. Gasc's Translator. Dictation. (2)
German.—Readings (continued). Compositions. (2)
Mineralogy.—Descriptive Mineralogy, with practical exercises in the determination of Minerals. (3)
Essays and Original Orations. (1)
Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

International Law.—Lectures: Woolsey. (2)

History.—Decline and Fall of the Roman Empire. (3)

Philosophy.—Haven's Moral Philosophy. (2)

Astronomy.—Loomis' Treatise, with Lectures. (3)

French.—Saintsbury: Specimens of French Literature. Readings in Corneille, Racine, Molière, etc., and Contemporary authors. Compositions. Lectures on French Literature. (2)

German.—Readings (continued). Compositions. Lectures on German Literature. (1)

In both languages, Conversation Class optional throughout the year.

Geology.—Williams' Lithology and Laboratory Practice. (2)

Essays and Original Orations. (1)

Gymnasium.

SECOND TERM.

Constitutional Law.—Lectures. (1)

History.—History of France. (2)

Philosophy.—History of Philosophy. (1) Philosophy of History. Lectures. (2)

Christian Evidences. (1)

French.—Readings (continued). Compositions. Lectures in French on Modern French authors. (2)

German.—Readings (continued). Compositions. Lectures in German on Modern German authors. (1)

Geology.—Historic, Dynamic and Economic Geology. Geikie. (2)

Lectures on American and English Literature. (2)

Preparation of Thesis.

Gymnasium.

THE SCHOOL OF TECHNOLOGY.

This School includes five distinct courses:

I. The Course in Civil Engineering.
II. The Course in Mechanical Engineering.
III. The Course in Mining and Metallurgy.
IV. The Course in Electrical Engineering.
V. The Course in Chemistry.

These have the same curriculum of studies for the first term of the Freshman year. At the end of that time the student selects his course and follows its program.

A course in Architecture, leading to the degree of Bachelor of Science, has been outlined, and the program of studies will appear in the Register for 1889-90. It will be parallel to the other courses in the school of Technology, and for the first year will be the same as the course in Civil Engineering.

FRESHMAN CLASS.

FIRST TERM.

Mathematics.—Chauvenet's Geometry (completed). (4)
Chemistry.—Lectures. Fownes' Elementary Chemistry. (4)
French.—Chardenal, First Course. Keetel's Analytical Reader. (3) Or *German.*—Joynes-Meissner's Grammar. Joynes-Otto's Reader. (3)
Drawing.—Free Hand Sketching. (2)
English.—Exercises and Declamations. (2)
Physiology and Health.—Lectures. (1)
Gymnasium. (2)

THE COURSE OF CIVIL ENGINEERING.

The special technical studies in this course may be grouped under the heads of Surveying, Applied Mechanics, Road and Railroad Construction, Bridge Design, and Hydraulic and Sanitary Engineering.

The work in Surveying extends over seven terms and embraces land surveying, leveling, topography, triangulation,

railroad reconnaissance and location, hydrography, and the elements of geodesy. A large equipment of transits, levels and other surveying tools, affords students the opportunity of becoming familiar with the instruments of different manufacturers. Much time is devoted to practice in the field and drafting room, each student being required to become proficient in the use of instruments, in taking field notes, and in map drawing. Particular attention is paid to the execution of a secondary triangulation of a high order of precision, and to the execution of topographical surveys and maps by the best modern methods.

The work in Applied Mechanics comprises the strength and elasticity of materials, the theory of the equilibrium of arches, roofs and bridges, that part of the mechanics of machinery which relates to locomotives and hoisting machines, and the theory of hydraulics and hydraulic motors. Here the theoretical principles are illustrated by examples and problems taken as far as possible from actual engineering practice.

The course in Construction familiarizes the student with the qualities of materials used in engineering structures, with methods of preservation and testing, with masonry and foundations, and with the building and maintenance of roads and railroads. Plans, drawings, and estimates of cost are prepared for the construction of a line of railroad, all details, such as drains, culverts, road crossings, etc., being worked out by each student.

The course in Bridge Design starts with the study of full specifications for a first-class iron highway or railroad bridge. Each student then makes the full computations, designs, working drawings, and bills of material for the particular span assigned him. The weight of the designed bridge is finally determined and compared with the dead load assumed for the calculations. The drawings are made and dimensioned in the same manner as in the drafting office of a bridge company. In connection with this course, visits of inspection to bridges in the vicinity are regularly made.

The work in Hydraulic and Sanitary Engineering em-

braces the study of systems of water supply, the collection, purification and distribution of water, the combined and the separate systems of sewerage, the methods for the disposal of sewage, and the best practice for the drainage and ventilation of houses. The hydraulic laboratory in the University Park affords opportunity for experiments on the actual measurement of water by means of weirs and orifices, and the testing of hydraulic motors.

Besides these special studies there is a course in astronomy which includes practical work in the observatory. The study of English, and of French or German, is continued, and instruction is given during four terms in crystallography, mineralogy, lithology and geology.

The student who completes all the studies of this course will receive the degree of Civil Engineer (C.E.)

FRESHMAN CLASS.

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

Surveying.—Theory of Chain and Compass Surveying. Computation of Areas. Elements of Leveling. (1)

French.—Chardenal, Second Course. (Reader continued). (3) Or *German.*—Grammar and Reader (continued). (3)

Drawing.—Projection Drawing and Descriptive Geometry. Warren's Elementary Projection Drawing. (4)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)

Physics.—Mechanics, Heat, and Electricity. Lectures. (5)

French.—Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

Drawing.—Isometric Drawing. Architectural Drawing. (2)

Surveying.—Use of the Compass, Level and Transit. Surveys and Maps of Farms. Colored Topography. (2)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics.—Differential and Integral Calculus: Olney and Courtenay. (4)

Physics.—Sound, Light and Meteorology. Lectures. (3)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Dictation. (2) Or *German.*—Grammar. Reading. Dictation. (2)

Mechanics.—Theory of motion, statics, energy, center of gravity, moment of inertia and general equations of motion. (4)

Surveying.—Profiles and Contour Maps. Hydrographic and City Surveying. Use of the Plane Table. Topographical Drawing. (3)

Essays and Declamations.

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Courtenay's Calculus, and Wood's Analytical Mechanics. (2)

French.—Readings. Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation Class in both languages optional throughout the year.

Surveying.—Triangulation. Leveling. Topographical Surveying with Transit and Stadia. Topographical Map. (4)

Strength of Materials.—Elasticity and Strength of Wood, Stone, and Metals. Theory of Columns, Shafts and Beams. Reports on the Testing of Materials. (4)

Construction.—Materials of Construction. Masonry. Foundations. Construction of Roads and Pavements. (2)

Crystallography.—Lectures, with practical exercises in the determination of Crystals. (2)

Literature and History. (1)

Gymnasium. (2)

SECOND TERM.

French.—Readings. Compositions. Lectures on French Literature. (2) Or *German*—Readings. Compositions. Lectures on German Literature. (2)

Surveying.—Theory of Railroad Curves. Railroad Reconnaissance and Location. Survey of a Line, with Profile, Map and Estimate of cost. (4)

Roofs and Bridges.—Theory and Calculation of Strains in Roof and Bridge Trusses. Graphical Statics. (3)

Construction.—Stone cutting, with practical Drawings. (2) Construction and Maintenance of Railroads. Theory of Retaining Walls and Stone Arches. (2)

Mineralogy.—Descriptive Mineralogy, with practical exercises in the Determination of Minerals. (3)

Essays and Original Orations.

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Astronomy.—Loomis' Treatise, with Lectures. (3)

Bridges.—Suspension, Continuous and Cantilever Bridges. Design of an Iron Bridge, with Working Drawings. (7)

Surveying.—Use of Solar Transit and Sextant. Precise Triangulation. Investigation of Systematic Errors of Instruments. (2)

Mechanics of Machinery.—Pile Drivers, Cranes, and Elevators. The mechanics of the Locomotive. (2)

Geology.—Williams' Lithology, with practical exercises in determining rocks. (2)

Gymnasium.

SECOND TERM.

Astronomy.—Doolittle's Practical Astronomy, with Observatory Work. (2)

Surveying.—Elements of Geodesy. The Figure of the Earth. Map Projections Elements of the Method of Least Squares. (2)

Hydraulics.—Hydrostatics. Efflux of water from orifices, and flow in pipes and rivers. Hydraulic motors. (2)

Hydraulic and Sanitary Engineering.—Collection, Purification and Distribution of Water. Systems of Water Supply. The Combined and the Separate System of Sewerage. Disposal of Sewage. House Drainage. Hydraulic Experiments. (5)

Geology.—Historic and dynamic. Geikie. (2)

Lectures on English Literature. (2)

Christian Evidences.—Lectures. (1)

Preparation of Thesis.

Gymnasium.

THE COURSE OF MECHANICAL ENGINEERING.

The object of this course is the study of the Science of Machines; the principal subjects taught are: the nature, equivalence and analysis of mechanisms, the mechanics or theory of the principal classes or types of machinery, Mechanical Technology and the principles and practice of Machine Design.

That the students may obtain the practical engineering data which they will most need when beginning their work as mechanical engineers, they are required to pursue a course of Shop Instruction which does not necessarily in-

volve manual labor and manipulation of tools, but is principally devoted to familiarizing them with those points in pattern-making, moulding, forging, fitting and finishing, which they need to know as designers of machinery Particular attention is therefore directed to the forms and sizes of machine parts that can be readily constructed in the various workshops, to the time that it takes to perform, and the order of, the various operations, to the dimensions most needed by workmen and to the various devices for increasing the accuracy of the work, durability of the parts and convenience of manipulation. This involves acquaintance with the processes and machinery of the workshops, but it is the foreman's and superintendent's knowledge which is required rather than the manual dexterity and skill of the workman and tool hand. The acquirements peculiar to the latter are by no means despised, and students are encouraged to familiarize themselves therewith during leisure hours, but manual work in the shops forms no regular part of the course. On the contrary, the student enters the shop with hands and mind free to examine all the processes, operations and machinery, and is ready at the call of the teacher, to witness any operation of special interest. Provided with note-book, pencil, calipers and measuring rule, the student sketches the important parts of the various machine-tools, notes down the successive steps of each of the important shop-processes as illustrated by the pieces operated upon, and follows pieces of work through the shops from the pig or merchant form to the finished machine.

That the students may learn to observe carefully and be trained to think and observe for themselves in these matters, there is required of them a full description of the various processes, operations and tools involved in the production of each one of a series of properly graded examples of patterns, castings, forgings and finished pieces which are not being constructed in the shops at the time and the blue prints for which have been given to them on entering the shops. The student's work is directed not only by these

drawings and by the printed program given him at the start, but also personally by a teacher, who accompanies him into the shops, gives necessary explanations, and tests the extent and accuracy of his knowledge by examining the sketches and notes and by frequent questioning. Finally the results of the observations and the sketches are embodied in a memoir.

During the course there are frequent visits of inspection to the Bethlehem Iron Co., the L. V. R. R. Shops at Easton, and other engineering works both in and out of town, with special reference to such subjects as Machine Elements, Prime Movers, Machinery for lifting, handling and transporting, and Machinery for changing the form and size of materials. It is intended that each of these excursions shall have some definite purpose in view which must be fully reported by the students. These visits are also made the occasion for constant practice in the Free Hand Sketching of Machinery.

The instruction in Machine Design begins with second term of the Freshman year and is continued throughout the course. At first tracings of good examples of machine drawings are made; then there is considerable drill in the interpretation of such drawings and general views of lathes, planers, drills and shapers are made from the drawings of the details. This is followed by difficult projections and intersections and exercises in the empirical proportioning of machine parts. Both empirical and rational formulas are used to determine the dimensions of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers and connecting rods, the data being given as they would arise in practice and the drawings made full size. During the Junior year the class takes up the design of a high speed steam engine, every dimension being determined by the students and complete drawings made. During the Senior year the students undertake the calculations, estimates and working drawings involved in the design of a simple but complete machine, each student being engaged upon a different machine. From the finished drawings of each machine, tracings are made and then blue prints

taken for distribution among the other members of the class. In the case of the machines and of the engine, the general plan or arrangement will be given to the students in the form of rough sketches, photographs or wood-cuts. In the last term the students are expected to make original designs for simple machinery, whose object has been fully explained. Throughout the course the work in the draughting room is carried on as nearly as possible like that of an engineering establishment, and special attention is paid to methods of expediting the work of calculation by means of simple formulas, tables and diagrams.

The graduate in this course will receive the degree of Mechanical Engineer (M.E.).

FRESHMAN CLASS.

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

French.—Chardenal, Second Course. Reader (continued). (3) Or *German.*—Grammar and Reader (continued). (3)

Machine Design.—Tracings. Interpretation of machine drawings by isometric sketches. General views from given details. Sections of stub ends and valve passages. Intersection of boiler flues. Empirical proportioning of machine parts. (5)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)

Physics.—Mechanics, Heat and Electricity. Lectures. (5)

Machine Design.—Proportioning of such machine parts as come under the head of fastenings, bearings, rotating and

sliding pieces, belt and toothed gearing, levers and connecting rods. (2)

Visits of Inspection.—Examination and sketching of principal machine parts in the shops of the vicinity. (2)

French.—Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics. — Differential and Integral Calculus: Olney and Courtenay. (4)

Physics.—Sound, Light and Meteorology. Lectures. (3)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Dictation. (2) Or *German.* — Grammar. Reading. Dictation. (2)

Mechanics.—Theory of motion, statics, energy, center of gravity, moment of inertia and general equations of motion. (4)

Steam Engine.—Rigg's Practical Treatise. (3)

Essays and Declamations. (1)

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Courtenay's Calculus and Wood's Analytical Mechanics. (2)

French.—Readings. Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation Class in both languages optional throughout the year.

Mechanical Technology.—Shop instruction. Examination of the processes and appliances involved in pattern making, moulding, forging, fitting and finishing, with sketches and reports. (7)

Boilers.—Wilson. Strength, construction and wear and tear of boilers. (1)

Strength of Materials.—Elasticity and strength of wood, stone and metals. Theory of beams, shafts and columns. Reports on experimental tests. (4)

Literature and History. (1)

Gymnasium. (2)

SECOND TERM.

French.—Readings. Compositions. Lectures on French Literature. (2) Or *German.* — Readings. Compositions. Lectures on German Literature. (2)

Kinematics of Machinery. Reuleaux. Nature and Equivalence of Mechanisms. (3)

Machine Design. - Calculations and Working Drawings for a High Speed Steam Engine. (5)

Metallurgy.—Metallurgical Processes. Furnaces. Refractory Building Materials. Combustion. Natural and Artificial Fuels. Metallurgy of Iron. (4)

Machinery of Transmission.—Weisbach-Herrmann. (2)

Essays and Original Orations.

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Thermodynamics.—General principles; application to Steam Engines and Air Compressors. (3)

Graphical Statics.—Graphical Analysis of Roof Trusses and Girders. (2)

Machine Design.—Calculations and working drawings for hoisting, pumping and metal-working machinery. (4)

Kinematics.—Diagrams of the changes of position, speed and acceleration in mechanisms. Link and valve motions. Quick return motions. Parallel motions. Laying out of Cams. (3)

Mechanics of Machinery.—Weisbach-Herrmann. Hoisting Machinery, Accumulators, Cranes and Locomotives. (4)
Gymnasium.

SECOND TERM.

Mechanics of Machinery.—Weisbach-Herrmann. Pumps, Pumping Engines, Blowing Engines, Compressors and Fans. (4)
Machine Design. - Original Designs. (5)
Hydraulics.—Hydrostatics. Flow of water in pipes and channels; hydraulic motors. (2)
Measurement of Power. - Indicating of Steam Engines; determination of evaporative efficiency of boilers; dynamometer experiments. (1)
Lectures on American and English Literature. (2)
Christian Evidences.—Lectures. (1)
Preparation of Thesis.
Gymnasium.

THE COURSE IN MINING AND METALLURGY.

This course aims to fit the student for practical work in either of the branches of Mining, Metallurgy, Metallurgical Chemistry, or Geology. On account of the great number and scope of the studies necessary to the completion of this course, it is five years in length. At the completion of the fourth year the student will have completed a course similar to that leading to the Scientific degree in other institutions and will receive the degree of Bachelor of Science in Mining and Metallurgy (B.S).

The graduate in this course will receive the degree of Engineer of Mines (E.M.), which includes that of Metallurgist.

CHEMISTRY.—The course in Theoretical and Applied Chemistry extends over three years and includes the

methods of wet and dry Assaying and Blowpipe analysis combined with the working of Stoichiometric problems and the Study of Chemical Philosophy. The practical work is that required for a Metallurgical Chemist or Assayer. With moderate care the expenses in this department need not exceed $120.

METALLURGY.—This course extends over one year and, after treating of the principles of the subject, enters minutely into the processes for the extraction and separation of metals from ores, with details of the necessary plants required and costs of extraction. A special laboratory attached to this department affords practical work in metallurgical problems.

GEOLOGY.—Three terms are devoted to Crystallography, Mineralogy, and Macroscopic Lithology. In each study, after a grounding of the theory of the subject, there is an extended course in practical determination of the most important species. There are from three to four hundred specimens to illustrate the first study and from three to five thousand hand specimens for each of the two latter. A year is then given to dynamic, historic and economic Geology, and this is supplemented by field work and the construction of maps and sections.

ASTRONOMY.—After studying the theory of the subject, two thirds of the year are devoted to practical work in the Observatory.

APPLIED MECHANICS.—This embraces Hydraulics, a study of the Steam Engine and the mechanics of machines employed in Mining and Metallurgy.

SURVEYING.—A course extending over five terms offers practice in land, mine, and geological surveying, leveling, topography, triangulation, and railroad reconnaissance and location. It also includes practical work in drawing and map construction.

MINING.—This course covers the theory and practice of locating and winning deposits with a full discussion of and practice in the engineering problems occurring in Mining, such as haulage, pumping, ventilation and hygiene, ore-dressing, and mining Law. A series of projects supplement the problems and give practical studies in Mining and Metallurgy.

The location of the University in the vicinity of the iron works of the Lehigh Valley and especially of the extensive establishment of the Bethlehem Iron Company, affords unusual facilities for the practical study of iron metallurgy. The processes for the manufacture of spelter and oxide of zinc may be studied at the Bethlehem Zinc Works. The facilities for the practical study of mining and economic geology are not excelled by those of any other Institution in the country. The zinc mines at Friedensville and the brown hematite and slate deposits of the Lehigh Valley are in the immediate vicinity, while within easy reach by rail are the anthracite coal fields of Pennsylvania, the iron and zinc mines of New Jersey, and the celebrated iron mines at Cornwall, Pa.

FRESHMAN CLASS.

SECOND TERM.

Mathematics.—Olney's University Algebra, Pt. III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic tables. (2)

French.—Chardenal, Second Course. Reader (continued). (3) Or *German.*—Grammar and Reader (continued). (3)

Drawing.—Projection Drawing and Descriptive Geometry. Warren's Elementary Projection Drawing. (4)

Surveying.—Theory of Chain and Compass Surveying. Computation of Areas and Leveling. (1)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics. — Analytical Geometry: Olney's General Geometry. (4)

Physics.—Mechanics, Heat and Electricity. Lectures. (5)

French. – Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

Drawing. — Isometric Drawing. Architectural Drawing. (2)

Surveying.—Use of the Level and Transit. Surveys and Maps of Farms. Colored Topography. (2)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics. — Differential and Integral Calculus: Olney and Courtenay. (4)

Mechanics.—Theory of motion, statics, energy, center of gravity, moment of inertia and general equations of motion. (4)

Chemistry.—Lectures and Laboratory Practice. Douglass and Prescott's Qualitative Analysis. (4)

Stoichiometry. (2)

French.—Grammar. O'Connor: Choix deContes Contemperains. Dictation. (2) Or *German.*—Grammar. Reading. Dictation. (2)

Essays and Declamations.

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Mathematics. – Courtenay's Calculus and Wood's Analytical Mechanics. (2)

Strength of Materials. — Elasticity and strength of wood, stone and metals. Theory of beams, columns and shafts. (4)

Crystallography. — Lectures, with Practical Exercises in the determination of Crystals. (2)

Surveying. — Triangulation. Leveling. Topographical Surveys with Transit and Stadia. Topographical Maps. (4)

Chemical Philosophy.—Cooke. (3)

French.—Readings. Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation Class in both languages optional throughout the year.

Literature and History.

Gymnasium. (2)

SECOND TERM.

Mineralogy. — Descriptive Mineralogy, with Practical Exercises in the Determination of Minerals: E. S. Dana. (3)

Blow-Pipe Analysis.—Lectures, with Practice. Plattner, Brush, or Nason and Chandler. (1)

Chemistry.—Fresenius' Quantitative Analysis. (3) The following analyses are executed by the student:

1. Iron Wire (Fe)
2. Copper Ore (Cu)
3. Silver Coin (Au, Ag, Pb, Cu)
4. Zinc Ore (Zn) By both Gravimetric and Volumetric Methods.
5. Bronze (Cu, Sn, Zn, Pb)
6. Spiegeleisen (Mn)
7. Lead Ore (PbS)
8. Ilmenite (TiO_2)
9. Iron Ore (Complete Analysis)

Steam Engine.—Rigg's Practical Treatise. (3)

Surveying.—Theory of Railroad curves. Railroad Reconnaissance and Location. Survey of a Line, with Profile, Map and Estimate of cost. (4)

French.—Readings. Compositions. Lectures on French Literature. (2) Or *German.*—Readings. Compositions. Lectures on German Literature. (2)

Essays and Original Orations.

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Thermodynamics.—General principles; application to Steam Engines and Air Compressors. (3)

Geology.—General Geological Definitions and Principles. Dynamic Geology. Dana. (2)

Lithology.—Williams' Lithology, with practical exercises in determining rocks. (3)

Chemistry.—Quantitative Analysis: Laboratory Work: Fresenius. (5) The following analyses are executed by the student:

10. Limestone (Complete Analysis)
11. Coal (Volatile Matter, Fixed Carbon, Ash, H_2O, S, P)
12. Slag (Complete Analysis)
13. Pig Iron (Complete Analysis)
14. Carbon in Steel (Volumetric)
15. Nickel Ore (Ni, Co)
16. Gas Analysis.

Assaying.—Including the Assay by the dry methods of Gold, Silver, Antimony, Mercury, Lead, Iron and Tin ores. Laboratory Work. Ricketts. (3)

SECOND TERM.

Metallurgy.—Metallurgical Processes. Furnaces. Refractory Building Materials. Combustion. Natural and Artificial Fuels. Metallurgy of Iron. (4)

Mining.—Modes of Occurrences of the Useful Minerals. Searching for Mineral deposits. Examination of Mining Properties. Boring. Mining Tools, Machines and Processes. Timbering and Masonry. Callon. André. Lectures. (3)

Geology.—Historic and Economic Geology. Lectures. Dana. (4)

Blow-pipe Analysis.—Practice. (1)

Hydraulics.—Hydrostatics. Flow of water in pipes and channels. Hydraulic motors. (2)

Surveying.—Mine Survey. Theory and Practice, with construction of Mine Maps. Tunneling and Shaft location. (2)

Gymnasium.

POST-SENIOR CLASS.

FIRST TERM.

Metallurgy.—Of Copper, Lead, Silver, Gold, Platinum, Mercury, Tin, Zinc, Nickel, Cobalt, Arsenic, Antimony and Bismuth. (5)

Mining.—Methods of Working. Underground Transportation. Hoisting, Drainage and Pumping. Ventilation and Lighting. Hygiene of Mines. (4)

* *Mechanics of Machinery.*—Weisbach-Herrmann. Hoisting Machinery, Accumulators, Cranes. (2)

Astronomy.—Descriptive Astronomy: Loomis. (3)

* *Surveying.*—Geological Survey: Mapping and cross-sectioning. (2)

SECOND TERM.

Mining.—Mechanical Preparation of Ores. Coal Washing. (2)

Mechanics of Machinery.—Pumps, Pumping-Engines, Blowing-Engines, Compressors and Fans. (4)

Astronomy.—Doolittle's Practical Astronomy, with Observatory Work. (2)

Drawing.—Mining Plant. Systems of Timbering. (3)

Projects.—In Mining, Geology and Metallurgy. (2)

Lectures on American and English Literature. (2)

Christian Evidences.—Lectures. (1)

Preparation of Thesis.

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* The Surveying is completed in the first half of the term by taking four exercises per week. The Mechanics of Machinery is then begun.

THE COURSE IN PHYSICS AND ELECTRICAL ENGINEERING.

In the arrangement of the details of this new course, the object has been to provide for those, who seek to fit themselves as Electrical Engineers, a preliminary training as complete and broad as that given to the members of the other schools. The requirements for admission, the mathematical and English studies, the modern languages and other outside branches are the same as those in the other technical courses. To these have been added such portions of the Mechanical Engineering Course, with which this course is most closely allied, as are necessary to give the student a general, but sufficiently accurate knowledge of machinery.

This preparation joined to the unusually full development of Physics — and especially of Electricity — will, it is thought, make a course sufficiently comprehensive and thorough for the proper training of candidates for this degree. The great success attending the large majority of the young men who have taken the one year's Course in Electricity, in their subsequent electrical work, warrants the belief that this broader and more extended course will attain its object.

The main feature of this new course is the prominence given to the subject of Physics. This extends through three years and while Electricity is specially developed, the other branches, Elementary Mechanics, Heat and Light are fully provided for. The opportunity is thus given to any one, who wishes to acquire a more extensive knowledge of Physics than the University curriculum has heretofore offered. The student is well drilled in the theory by means of lectures and recitations, which carefully cover the whole subject and he is required to go over the ground himself in the best of all schools—the working laboratory. Enough of work on each topic is given him to render him familiar with his subject. Much prominence is given to work that brings out the resources of the student himself, such as the construction of instruments and original investigation. He

is encouraged to this and a regular portion of his time is set apart for this object.

It will be seen from the preceding statement that this course offers two great advantages; the thorough and extensive training of those intending to take parts in the great development of Electric Science in the industrial field now going on and the facilities offered to those who wish to take a four years' course specially devoted to the whole branch of Physics.

The degree of Electrical Engineer (E.E.) will be given to the graduates of this course.

FRESHMAN CLASS.

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

Chemistry.—Lectures and Laboratory Practice. Douglass and Prescott's Qualitative Analysis. (2)

French.—Chardenal, Second Course. Reader (continued). (3) Or *German.*—Grammar and Reader (continued). (3)

Drawing.—Projection Drawing and Descriptive Geometry. Warren's Elementary Projection Drawing. (3)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)

Mechanics, Sound and Heat.—(Theory, lectures and recitations.) (3)

Mechanics.—(Physical Laboratory). Exact Measurements. Density. Elasticity. Tenacity. Hydrostatics. Specific Gravity. Atmospheric Pressure (with barometric leveling.) Gravitation. Moments of Inertia.

Sound.—Determination of velocities and wave lengths. Measurements of vibrations. Verifications of laws of vibrations of sounding bodies.

Heat.—Construction of Instruments. Thermometry. Expansion. Conduction. Radiation. (4)

Drawing.—Isometrical Drawing. Architectural Drawing. (2)

French—Grammar. Reading. Or *German.*—Grammar. Reading. (2)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics.—Differential and Integral Calculus: Olney and Courtenay. (4)

Heat.—Continued. (Physical Laboratory.) Fusion and Vaporization. Calorimetry. Hygrometry. Elementary Thermodynamics. (3)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Dictation. (2) Or *German.*—Grammar. Reading. Dictation. (2)

Mechanics.—Theory of motion, statics, energy, center of gravity, moment of inertia and general equations of motion. (4)

Steam Engine.—Rigg's Practical Treatise. (3)

Essays and Declamations.

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Courtenay's Calculus and Wood's Analytical Mechanics. (2)

French.—Readings. Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation Class in both languages optional throughout the year.

Light and Magnetism.—(Theory ; text-books and lectures.) (3)

Light.—(Physical Laboratory). Investigation of general Principles and Laws. Determination of Focal Lengths and Indices of Refraction, Testing and Adjustment of Optical Instruments. Spectroscopic Analysis. Photometry. Polarization. Diffraction.

Magnetism.—Fundamental Experiments. Verification of Laws of Magnets. Study and Mapping of Lines of Force. Determination of Moments of Magnets ; and of horizontal component and whole intensity of Earth's Magnetism in absolute units. Distribution of Magnetism. (3)

Meteorology.—Text-book and practice. Observations for several months as taken in the U. S. Signal Service stations ; with all the usual corrections and reductions ; construction of charts ; mapping curves ; reports etc. (1)

Strength of Materials.—Elasticity and strength of wood, stone and metals. Theory of beams, columns and shafts. (4)

Boilers.—Wilson. Strength, construction and wear and tear of boilers. (1)

English.—Exercises and Declamations.

Gymnasium. (2)

SECOND TERM.

Electricity.—Theory ; text-books and lectures. (3)

Static Electricity.—(Physical Laboratory). Investigation of Principles. Quantitative Laws. Measurements of Potential, Capacity, etc. Induction. Condensation. Analysis of Machines.

Voltaic Electricity.—Management and care of a large variety of batteries. Construction of Instruments. Determination of Constants. Electro-Magnetism. Induction. Electro-Dynamics. Electrical Measurements of Potential,

Resistance and Current Strength. Electrolysis. Electroplating. Electrotyping. Thermo-Electricity. Secondary Batteries. Relation of Electrical Currents to Heat and Mechanical Work. (5)

French.—Readings. Compositions. Lectures on French Literature. (2) Or *German.* – Readings. Compositions. Lectures on German Literature. (2)

Machine Design.—Calculations for a High Speed Steam Engine. Proportioning of such machine parts as come under the head of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers and connecting rods. (5)

Literature and History.—Lectures. (1)

Essays and Original Orations.

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Dynamic Machines.—Theory, text-book and lectures. (2) (Physical Laboratory). Practical running and care of dynamos and motors. Measurements of magnetic field, potential, resistance and heating. Visits to manufactories and working systems. (2)

Electric Lighting.—Lectures. (2) (Physical Laboratory). Study of different systems. Calculations and arrangement of plant. Wiring. Insulation. Photometric tests of different arc and incandescent lamps. Determination of heat units given off by various incandescent lamps ; their resistance (hot and cold). Energy consumed in lamps and conductors. Spectroscopic tests of purity of carbons. (3).

Machine Design.—Proportioning of Machine Parts (continued). (2)

Astronomy.—Loomis' Treatise, with Lectures. (3)

Graphical Statics of Mechanism.—Herrmann—Smith. (2)

Scientific Readings.

Gymnasium.

SECOND TERM.

Telegraphs and Telephone.—Investigation of different systems. Arrangement of lines and stations. Test of lines for conductivity, insulation, location of faults etc. (2)

Application of Electricity to Railways.—Theory of the two systems, with inspection of electric railways. (1)

Measurement of Power.—Indicating of Steam Engines; dynamometer experiments. (1)

Dynamic Machines.—(Physical Laboratory). Tests of Efficiency in Generators and Motors etc. (1)

Physics.—Original Investigation. (5)

English Literature.—Lectures on English and American Literature. (2)

Christian Evidences. (1)

Preparation of Thesis.—(With laboratory work).

Gymnasium.

THE COURSE IN CHEMISTRY.

This course of study is designed to prepare students for the profession of the Chemist, in connection with metallurgical establishments, sugar refineries, gas works, superphosphate works, electrical machinery manufactories, mining companies, etc., and the general consulting and analytical work of the Professional Chemist. It is also well adapted for the preparation of teachers of chemistry and as a preliminary course to the study of medicine. It is eminently practical, the student's time being largely occupied by practical work in the large, well equipped and well ventilated chemical laboratories, which were completed in 1885 and constitute the best contructed building for this purpose in this country. The museum of Chemistry contains large collections of specimens, for illustrating the lectures on theoretical and applied Chemistry.

THEORETICAL CHEMISTRY.—Instruction in this subject begins with lectures four times a week, in the first term of the Freshman year; these lectures are fully illustrated by

experiments, colored diagrams, working drawings and lantern pictures and specimens from the museum. They include a general introduction to Theoretical Chemistry and a description of the non-metallic and metallic elements and their compounds, the general subject of inorganic chemistry. The students are required to take notes of the lectures, and to pass a written examination at the end of the term.

In the second term of this year Stoichiometry and chemical problems and reactions are taught by recitations twice each week.

The study of Theoretical Chemistry is continued throughout the Sophomore year, by recitations three times a week from Cooke's Chemical Philosophy and is concluded in the first term of Junior, by a course of lectures and recitations on Theoretical Organic Chemistry, four times a week. These lectures are illustrated by experiments and by specimens from the museum of Chemistry.

Written examinations are held at the close of each of the above courses.

Analytical Chemistry. — Qualitative Analysis is taught in the second term of the Freshman year, by lectures, recitations and practical work in the Qualitative Laboratory, twelve hours of practical work per week being required. This laboratory is a large, well ventilated and well lighted room, and supplied with convenient working tables, vacuum filtration, hoods for noxious vapors, steam baths, gas and washing appliances and a commodious room for hydrosulphuric acid. Distilled water is delivered by faucet in this room and the other large laboratories. At the close of the term a practical examination is held in this subject.

After completing this course, Quantitative Analysis is taken up throughout the Sophomore and the first term of the Junior years. This subject is taught by lectures, recitations and practical work in the Quantitative Laboratory, which is equipped similarly to the Qualitative Laboratory,

but is supplied in addition with apparatus for drying precipitates and residues, rooms for the chemical balances, for combustions, and for a reference library.

Twelve hours per week are required during the first term of the Sophomore year and fifteen hours during the second term of that year and the first term of the Junior year.

The course consists in Gravimetric and Volumetric Analyses, as applied to the substances given in the lists farther on, accuracy being required in the determination of each constituent.

At the close of each term, written examinations are held upon the theory and practice of Quantitative Analysis.

Gas Analysis is taught by lectures and laboratory practice in the Gas Laboratory. This laboratory is supplied with full and complete apparatus for Gas Analysis, according to Bunsen's processes, as well as apparatus for some of the more rapid methods. Mixtures of gases are required to be analyzed by the students, within certain limits of error, and a written examination, on the theory and practice, is held at the close of the course.

Assaying.—The Assaying of ores by furnace assay, together with gold and silver bullion analysis, by processes practiced in the United States Mint, is taught by lectures and practical work in the first term of the Junior year, nine hours of practical work per week being required. The course includes the assaying of ores of lead, tin, antimony, gold, silver and iron, coal, and gold and silver bullion.

The Assaying Laboratory is supplied with large working tables, twenty-nine crucible and two iron furnaces, and eight muffle furnaces, with adjoining rooms for balances, and gold and silver bullion analysis.

A certain accuracy of results and a written examination as regards the theory and practice are required.

Organic Chemistry.—The practical work in this subject is performed in the second term of the Junior and first term of the Senior years, fifteen hours during the former

and twelve hours during the latter term being required, with conferences and recitations each week. The laboratory for this work is equipped similarly to the Quantitative Laboratory, in addition being supplied with steam heat, cold water and air blast upon the working tables, and a full supply of apparatus for the various determinations and experiments, including combustion furnaces, furnaces for heating sealed tubes, mercury pump, Hoffman's, Dumas' and Meyers' apparatus for vapor densities, nitrometers, chemical balances, etc.

The course consists of determinations of specific gravities, melting points, boiling points, vapor densities, chlorine, bromine, iodine and sulphur of organic substances.

Combustion analysis, nitrogen determination, fractional distillation, and the preparation of several pure organic compounds and their analysis are included.

Industrial Chemistry. — A course of lectures is delivered upon this subject in the second term of the Senior year, illustrated by experiments, diagrams, lantern pictures and specimens from the museum of Chemistry. The working laboratory for this subject contains an apparatus for making illuminating gas, an alcohol still, worm and double and a complete working model of a sugar refinery, including filters, vacuum pan and centrifugal. In connection with this laboratory is a room containing a photometer and apparatus for determining the sulphur, ammonia and specific gravity of illuminating gas; also a laboratory for the testing of alcoholic liquors, sugar, molasses, bone black, soap, petroleum, paints, dyes, superphosphates and other commercial products, with the necessary technical apparatus. The students make practical experiments in this direction, and, with an instructor, visit various industrial establishments in this neighborhood and in and around New York City.

Toxicology. — A course of lectures on this subject is given in the first term of the Junior year, illustrated by experiments and by the large collection of specimens of

poisons from the museum of chemistry. This is supplemented by a short course of laboratory work on some of the common poisons.

Sanitary Chemistry. — During the second term of the Senior year, attention is given to the qualitative and quantitative examination of air, water, food, disinfectants, and other subjects connected with this branch of the science. Special apparatus is provided for this work, as recommended by the best authorities on the subject.

Photographic Chemistry. — Well equipped Photographic Laboratory and dark rooms are provided, in which the students of the chemical course receive practical instruction.

Physiological Chemistry. — The examination of urine, blood, etc., receives a proper amount of attention.

The course also includes instruction in physics, mineralogy, blowpipe analysis, metallurgy and geology, which are of great value to the chemist.

In the last term of the Senior year, the student is required to prepare a Thesis on some subject, selected by the Professor of Chemistry, involving practical work in the laboratory in addition to the literary labor, each graduate thus making a contribution to the progress of the science, as a preliminary to the reception of his degree.

The graduate of this course receives the degree of Analytical Chemist. (A.C.)

Students, not candidates for a degree, are admitted for special courses in chemistry, of which they receive certificates.

The Laboratories are under the immediate charge of the Professor and Instructors of Chemistry and are open to the students from 8 o'clock, A.M., to 6 o'clock, P. M., including Saturdays. Students are at liberty to work in the Laboratories, beyond the required hours, as their time may permit. Students are charged for materials and apparatus consumed; with moderate care this expense need not exceed $50 per year.

FRESHMAN CLASS.

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

Chemistry.—Lectures and Laboratory Practice. Douglass and Prescott's Qualitative Analysis. (4)

French.—Chardenal, Second Course. Reader (continued). (3) Or *German.*—Grammar and Reader (continued). (3)

Stoichiometry. (2)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Chemical Philosophy.—Cooke. (3)

Quantitative Analysis.—Fresenius' Quantitative Analysis. (4)

The following analyses are executed by the student:

1. Iron Wire (Fe)
2. Potassium Dichromate (Cr_2O_3)
3. Barium Chloride (Ba, Cl, H_2O)
4. Magnesium Sulphate (MgO, SO_3, H_2O)
5. Disodium Hydrogen Phosphate (P_2O_5)
6. Rochelle Salt (K_2O, Na_2O)
7. Volumetric Determination of Chlorine.
8. Acidimetry (HCl, H_2SO_4, HNO_3, $HC_2H_3O_2$)
9. Alkalimetry (KOH, NaOH, NH_4OH, Soda Ash, Pearl Ash)
10. Chlorimetry (Bleaching Powders)

Quantitative Analysis—Conference. (1)

Physics.—Mechanics, Heat and Electricity. Lectures. (5)

French.—Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

English.—Exercises and Declamations. (1)

Gymnasium. (2).

SECOND TERM.

Physics.—Sound, Light and Meteorology. Lectures. (3)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Dictation. (2) Or *German.*—Grammar. Reading. Dictation. (2)

Quantitative Analysis.—Fresenius' Quantitative Analysis. (5)

The following analyses are executed by the student:

11. Copper Ore (Cu)
12. Zinc Ore (Zn). By both Gravimetric and Volumetric Methods.
13. Lead Ore (Pb, S)
14. Silver Coin (Au, Pb, Ag, Cu)
15. Spiegeleisen (Mn)
16. Copper Alloys. (Complete Analysis.)
17. Ilmenite (TiO_2)
18. Iron Ore (Complete Analysis)
19. Limestone (Complete Analysis)
20. Coal (Volatile Matter, Fixed Carbon, Ash, H_2O, S, P)
21. Slag (Complete Analysis)

Quantitative Analysis.—Conference. (1)

Blow-Pipe Analysis.—Lectures, with Practice. Plattner, Brush, or Nason and Chandler. (1)

Chemical Philosophy. (3)

Essays and Declamations. (1)

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Toxicology.—Lectures. (2)

Quantitative Analysis.—Fresenius' Quantitative Analysis. (5)

The following analyses are executed by the student:

22. Guano (NH_3, P_2O_5, H_2O)
23. Clay (Complete Analysis)
24. Manganese Ore (MnO_2)

25. Mineral Water (Complete Analysis)
26. Pig Iron (Complete Analysis)
27. Nickel Ore (Ni, Co)
28. Carbon in Steel (Volumetric)
29. Gas Analysis.

Quantitative Analysis.—Conference. (1)

Organic Chemistry.—Lectures and Recitations. (4)

Crystallography.—Lectures, with Practical Exercises in the Determination of Crystals. (2)

French.—Readings. Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation Class in both languages optional throughout the year.

Gymnasium. (2)

SECOND TERM.

Organic Chemistry.—Laboratory. (5)

Organic Chemistry.—Conference. (1)

Metallurgy.—Metallurgical Processes. Furnaces. Refractory Building Materials. Combustion. Natural and Artificial Fuels. Metallurgy of Iron. (4)

French.—Readings. Compositions. Lectures on French Literature. (2) Or *German.*—Readings. Compositions. Lectures on German Literature. (2)

Mineralogy.—Descriptive Mineralogy, with Practical Exercises in the Determination of Minerals. E. S. Dana. (3)

Essays and Original Orations. (1)

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Metallurgy.—Of Copper, Lead, Silver, Gold, Platinum, Mercury, Tin, Zinc, Nickel, Cobalt, Arsenic, Antimony and Bismuth. (5)

Assaying.—Including the Assay by the dry methods of

Gold, Silver, Antimony, Lead, Iron and Tin ores, Coal, Gold and Silver Bullion and rich Lead. Ricketts. (3)

Organic Chemistry.—Laboratory. (4)

Organic Chemistry.—Conference. (1)

Geology.—Williams' Lithology, with Practical Exercises in determining rocks. (3)

Gymnasium.

SECOND TERM.

Industrial Chemistry.—Lectures and Laboratory. (4)

Agricultural Chemistry.—Lectures. (1)

Sanitary Chemistry.—Laboratory. (1)

Geology.—Historic and Dynamic Geology. Lectures. Geikie. (2)

Christian Evidences.—Lectures. (1)

Lectures on American and English Literature. (2)

Preparation of Thesis. (5)

Gymnasium.

PHYSICAL CULTURE.

The Gymnasium is open morning, afternoon and evening, in all, 45 hours a week. Exercise in it is required of all students who are fitted to take it. Class drill with the Instructor and individual exercise are prescribed.

GRADUATING THESES.

Every student will be required to present a thesis upon some topic connected with his special course, as a necessary portion of the exercises for his final examination for a diploma. These theses shall be accompanied by drawings and diagrams, when the subjects need such illustration. The originals will be kept by the University, as a part of the student's record, for future reference; but a copy may be retained by the student, and be published, permission being first obtained from the President.

DIPLOMAS AND CERTIFICATES.

The Diploma is given only to those who have passed all the examinations in a regular course and is signed by the President and Secretary of the Board of Trustees and by the Faculty of the University. For all the partial courses a certificate, signed by the President and the Secretary of the Faculty, is given showing what the student has accomplished.

GRADUATE STUDENTS.

Graduate students wishing to remain a year or more and pursue a course of study as candidates for another Degree may do so with the sanction of the Faculty. Those wishing to take *special* courses of study will be afforded every facility for so doing.

POST GRADUATE DEGREES.

M. A.

The Faculty will recommend for the Degree of Master of Arts any Candidate, otherwise properly qualified, who, after taking at this University the Degree of Bachelor of Arts, shall pursue, for at least one year at this University, or two years elsewhere, a course of liberal study prescribed by the Faculty in at least two departments, pass a satisfactory examination in the same and present a satisfactory Thesis.

M. S.

The Faculty will recommend for the Degree of Master of Science any Candidate, otherwise properly qualified, who, after taking at this University the Degree of Bachelor of Science, or any Degree in the School of Technology, shall pursue, for at least one year at this University, or two years elsewhere, a course of study prescribed by the Faculty in at least two departments, pass a thorough examination in the same and present a satisfactory Thesis.

Ph. D.

The Faculty will recommend for the Degree of Doctor of Philosophy any Candidate, otherwise properly qualified, who, after taking at this University the Degree of Master of Arts or Master of Science, shall pursue, for at least one year at this University, or two years elsewhere, a course of advanced study prescribed by the Faculty, in at least two departments, pass a thorough examination in the presence of the Faculty in the same and present a satisfactory Thesis giving evidence of original investigation.

The Candidate shall have a good knowledge of Latin and either French or German.

The Theses presented by Candidates for Post Graduate Degrees shall be retained by the University.

Applicants for any of these degrees will be required to complete the prescribed work within the allotted time. Special action of the Faculty is required for any extension of time.

THE UNIVERSITY LIBRARY.

The Library building was erected by the Founder of the University in 1877, at a cost of One Hundred Thousand Dollars, as a memorial of his daughter, Mrs. Lucy Packer Linderman, and during the same year more than Twenty Thousand Dollars were contributed by her family and friends, as a memorial fund for the purchase of books. By the will of the Founder of the University a fund of $500,000 has been given for the permanent endowment of the library.

The building is semi-circular in plan, with a handsome façade in the Venetian style of architecture. It is constructed of Potsdam sandstone with granite ornamentation. In the interior, the center is occupied as a reading space, fifty by forty feet, from which radiate the book cases, extending from floor to ceiling; two galleries affording access to the upper cases. Shelf room is now provided for one hundred and sixty thousand volumes. The building is thoroughly fireproof, well lighted, and heated by steam.

Seventy-five thousand volumes are now upon the shelves, including many extremely valuable works. The list of periodicals numbers about one hundred and twenty-five, embracing as far as possible all departments of knowledge.

The Library is conducted strictly for consultation, and is open to the use of the public; both of which conditions are in accord with the terms of the gift.

REGULATIONS OF THE LEHIGH UNIVERSITY LIBRARY.

I. The Library is open every day, except Sundays and Legal Holidays, from 8 A. M. until 10 P. M., and on Sundays for the students and others connected with the University from 1.30 P. M. until 9.30 P. M.

II. Admission is free to all persons over 16 years of age.

III. Readers are required to write their names and addresses in the Daily Register of the Library. They also write the name of the book desired upon a Library Card, with their signatures, and present the same to the Director's Clerk, who supplies the book, retaining the card as a receipt. Before leaving the Library, readers return their books to the clerk, and receive their cards.

IV. The University Professors and Instructors, only, are allowed to take books from the Library Building.

V. No person is allowed to enter the alcoves, or remove any book from the shelves, without permission of the Director.

VI. Readers wishing to consult the more valuable illustrated works make special application for that purpose.

VII. In taking notes, pencils, and not pens and ink, are to be used.

VIII. Audible conversation and the use of tobacco are strictly forbidden in any part of the Library.

IX. Any person not conforming to these Regulations, will be denied the privilege of the Library.

X. Any person, who defaces, in any way, any book, magazine or paper, or the furniture, or any portion of the building, in addition to being deprived of the privileges of the Library, will be prosecuted according to law.

OBSERVATORY.

By the liberality of Robert H. Sayre, Esq., one of the Trustees of the University, an Astronomical Observatory was erected on the University grounds, and placed under the charge of the Professor of Mathematics and Astronomy.

In the dome of the Observatory is mounted an Equatorial Telescope, of six inches aperture, by Alvin Clark & Sons. The west wing contains a superior Sidereal Clock, by Wm. Bond & Sons; a Zenith Telescope, by Blunt, and a Field Transit, by Stackpole. There is also a Prismatic Sextant, by Pistor & Martins.

Students in Practical Astronomy receive instruction in the use of the instruments and in actual observation.

The grounds upon which the Observatory stands, consisting of seven acres of land adjoining the original grant, was presented to the University by Charles Brodhead, Esq., of Bethlehem.

An advanced course in Astronomy and the higher Analysis has been established, requiring two years for its completion. It is adapted to the attainments of the graduates of this University, but, is open to any one who may be prepared to pursue it.

This course embraces the following subjects:

First Year.—Spherical Astronomy. Theory of Instruments. Method of Least Squares. Numerical Calculus.

Second Year. – Celestial Mechanics. Interpolation and Quadrature. Computation of Orbits and Perturbations.

During the entire course the student will have ample opportunity to familiarize himself with the practical work of the Observatory and Computing Room.

THE PACKER MEMORIAL CHURCH,

is the recent and munificent gift of Mrs. Mary Packer Cummings, daughter of the Founder of the University. It is a large and magnificent Church, richly furnished and handsomely appointed in every particular. There is no more beautiful Church edifice in the State and it is one of the noblest in all the land. It is under the Rectorship of the Right Reverend Nelson Somerville Rulison, D.D., Assistant Bishop of Central Pennsylvania, with the Chaplain of the University as Assistant.

THE UNIVERSITY MUSEUM.

In addition to the large collection illustrating all branches of Industrial Chemistry, the Museum includes collections in Metallurgy, Geology, Zoology, and Archæology.

The Metallurgical Cabinet already includes specimens illustrating the various processes for obtaining the more common metals.

The Zoological Cabinet includes the Werner collection of nearly all the types of American birds with their nests and eggs, and the Packer collection of recent shells.

The Geological Cabinet numbers over ten thousand specimens and includes the Palæontological, Mineralogical, Petrographic and Economic collections. The former contains good specimens of nearly all the common genera. The Mineralogical division includes the Keim and Rœpper collections—the latter being especially complete and valuable from a crystallographic stand-point. The Petrographic division numbers several thousand specimens and besides including numerous varieties of nearly all the rocks of the globe, contains a duplicate set from the collection of the Second Geological Survey of this State. The Economic division was formed and donated by Dr. James P. Kimball, Director of the Mint, and formerly Professor of Economic Geology.

The Cummings Archæological Cabinet numbers three thousand specimens and includes Dr. Stubbs' Collection of Indian relics, weapons, and utensils.

THE CHEMICAL AND NATURAL HISTORY SOCIETY OF THE LEHIGH UNIVERSITY.

This Society was organized in the Fall of 1871, as "The Chemical Society," but was afterwards expanded, as its present title indicates, and admits, by election, students from all departments of the University.

The collections of Botanical and Zoölogical Specimens belonging to the Society, are already important. During the past years persons have been sent to Texas and Brazil to collect specimens for these cabinets.

The Society has organized and maintained several courses of public scientific lectures.

Among the honorary members of the Society are more than one hundred of the most distinguished scientists in Europe and the United States.

The annual address was delivered by Prof. Ira Remsen, on June 16, upon "The Relations between Chemical Science and Chemical Industry."

THE ENGINEERING SOCIETY.

This society was organized in 1873, and admits, by election, students in the Junior and Senior Classes. Its meetings are held fortnightly. At these, papers relating to engineering subjects are read and discussed. It issues quarterly "The Journal of the Engineering Society" to which the members and others contribute.

THE MINING CLUB.

This was organized in 1883 and takes from the Junior, Senior, and Post Senior Classes, those members of the Mining School who excel in their studies or in practical experience in the subjects of the course.

THE ELECTRICAL ENGINEERING SOCIETY

was organized in November, 1887, by students in the Advanced Course in Electricity. Its object is to supplement the regular work of the department by the study and discussion of electrical subjects.

THE AGORA

is a Literary Society which meets semi-monthly—only students in the Course of General Literature are eligible to membership.

THE ATHENÆUM.

is also a Literary Society whose active membership is confined to the Sophomore Class. The meetings are held weekly.

THE UNIVERSITY GUILD

is a Society for the promotion of the religious, mental, moral and social life of the students of the University. The Right Reverend, the Assistant Bishop of Central Pennsylvania, is Honorary President and the Chaplain of the University, Honorary Vice-President. Its meetings are held fortnightly at the residence of the Chaplain. It is an active and flourishing society of important and growing influence.

FOUNDER'S DAY.

On the second Thursday of October of each year Commemorative Exercises are held in honor of the Founder of the University.

WASHINGTON'S BIRTHDAY.

This day is observed as a holiday.

On Wednesday, February 22, 1888, exercises were held in the Chapel, and orations were delivered by Messrs. Morrow, Campbell, Farwell, Throop and Atkinson.

UNIVERSITY SERMON.

This sermon is preached on the Sunday before University Day.

The Rev. Samuel D. McConnell, D.D., was the preacher on Sunday, June 17, 1888, in the Memorial Church.

THESES.

Theses on the following subjects were prepared by the graduating class of 1888.

"Hydraulic Forging Machine."

CHARLES LAMBERT ADDISON.

"Mechanical Refrigeration."

GEORGE READE BALDWIN.

"Four American Centennials."

CHARLES LINCOLN BANKS.

"The Use of the Gradienter, and the Precision of Gradienter Measurements."

EDMUND A. BATES.

"A Review of the Pratt Truss Skew Bridge, Pennsylvania Railroad, near Pottsville, Pa."

WILLIAM DONALDSON BEATTY.

"Review of the Iron Highway Bridge over the Schuylkill River at Royersford, Pa."

HUBERT ALEXANDER BONZANO.

"The Discharge and Mean Velocity of the Lehigh River, at Different Stages of Water."

WILLIAM BRADFORD.

"Experiments on the Radiation of Heat from Locomotive Boilers."

ADOLPH THEODORE BRUEGEL.

"Computations of Earthwork in Railroad Location."

CHARLES NOBLE BUTLER.

"Economic Location of Radebaugh Branch, S. W. Pa. Ry. with Designs for the Required Structures."

MORTON LEWIS BYERS.

"Design for a Radial Drill."

JOHN JESSE CLARK.

"The Water Supply of Reading, Pa."

GEORGE PHILIP CONNARD.

"The Friedensville Zinc Mines as a Water Supply of the Bethlehems, with Estimates of the Costs."

REUBEN DANIELS.

"Design of a Steel Highway Bridge, with Specifications."

GEORGE HERSCHEL DAVIS.

"The Canal and Slack Water Navigation of the Schuylkill River."

WILLIAM SCHAFF DAVIS.

"The Coal Cars of the Lehigh Valley Railroad."

PHILIP HOFFECKER DE WITT.

"An Investigation of Retaining Walls."

MANUEL VICTOR DOMENECK.

"On Coupling the Pittsburgh Pumping Engines."

GEORGE PATTERSON DRAVO.

"The Construction and Maintenance of Roads within Twenty Miles of Bethlehem."

CHARLES WESLEY FOCHT.

"Design for a Five-Ton Portable Crane."

GEORGE STEINMAN FRANKLIN.

"Discussion of Lehigh University Precise Triangulation with Comparison of Astronomical and Geodetic Co-ordinates of the Sayre Observatory Dome."

SAMUEL WILSON FRESCOLN.

"Precision of Stadia Measurements."

WILLIAM GATES, JR.

"Analysis and Design of Valve Gearing and Balanced Valve for Twenty Horse Power High Speed Engine."

JAMES BOLAN GLOVER.

"Design for a Shaping Machine."

HUGHLETT HARDCASTLE.

"Locomotives with Compound Cylinders."

GEORGE AUGUSTUS HART.

"Switches, Frogs and Crossings."

STERRY HENRY JENCKS.

"The Separation of the Isometric Amylic Alcohols formed by Fermentation."

FREDERICK HAYES KNORR.

"Forms of Railroad Rails and their Relation to the forms of Wheel Flanges."

JAMES STRUTHERS MACK.

"Construction and Investigation of Brinton Ribbed Arch, over Turtle Creek, on the Pittsburgh Division, Pennsylvania Railroad."

CHARLES DONNELL MARSHALL.

"Masonry Bridges for Railroad Purposes."

HOWARD HALE MCCLINTIC.

"Determination of Cylinder Condensation with Analysis of Experiments."

WALTER ASHFIELD MCFARLAND.

"The Analysis of a Meteorite."

HOWARD LEOSER MCILVAINE.

"The Future Water Supply of the Bethlehems, with a Precise Determination of the Capacity of the South Bethlehem Reservoirs."

CHARLES HENRY MILLER.

"Plate Girders vs. Stone Arches."

GEORGE PHILIPS MILLER.

"The Georges Creek & Cumberland Railroad"

JOHN HOFF MILLHOLLAND.

"Photography."

HARLAN SHERMAN MINER.

"Design of an Hydraulic Ingot Crane."

HARRY SEMPLE MORROW.

The Intense Element in American Literature."

WILLIAM LYNVILLE NEILL.

"The Chemistry of Coal Gas, Water Gas and Natural Gas."

HOWARD SEGAR NEIMAN.

"Discussion of Base Line Measurements made at Lehigh University in 1886 and 1887."

HARRY PALMER.

"A Review of the Water Supply of Newark, N. Y."

CHARLES JEREMIAH PARKER.

"The Manufacture of Sulphuric Acid of 62° Baumé."

ROBERT SWAIN PERRY.

"The Formation of Modern Europe."

ALBERT GEORGE RAU.

"A Review of Inter-Oceanic Canal Schemes."

CLARENCE ELMER RAYNOR.

"A Comparison of Economy between two Systems of Bridges of Three Hundred Feet Span."

WILLIAM PEMBERTON RICHARDS.

"Slope or Stripping; a Comparison of the Advantages of these two Methods of Mining Coal."

OSMOND RICKERT.

"Plan for the Separate System of Sewage, South Bethlehem, Pa."

EUGENE HICKS SHIPMAN.

"Comparison of Three Locomotive Valve Gears."

WILLIAM ALONZO STEVENSON.

"Design for an Open-Side Planer."

WILMER MARSHALL WEBB.

"Design of a Wrought-Iron Deck Bridge of 96′ 9″ span, and a Comparison with a Through Bridge of the same length."

HARVEY MUSSER WETZELL.

"Review of the Chesapeake & Delaware Canal."

WINTER LINCOLN WILSON.

"Design of a Steel Railroad Bridge and a Comparison with a Wrought-Iron Bridge of the same Span."

EDWARD BENJAMIN WISEMAN.

"Review of Japanese Railways based upon Wellington's Economic Theory of Railroad Location."

SHUNTARO YAMAGUCHI.

"Comparison of Six Cantilever Trusses of Equal Span."

LUTHER REESE ZOLLINGER.

THESES FOR THE DEGREE OF E.M.

"Heat Requirement of an Anthracite Blast Furnace."

FRANK FIELDING AMSDEN.

"Review of the Method of Preparing Anthracite Coal at Lyken's Valley."

ROBERT WEBB BARRELL, B.M.

"A Review of the South Welsh Method of Copper Smelting as practiced by the Baltimore Copper Smelting & Rolling Company."

HENRY BENJAMIN CHARLES NITZE, B.S.

"The Clapp-Griffiths Process."

FRANCIS WILLIAM BURCHAL PILE, B.S.

"The Manufacture of Charcoal and Wood Alcohol."

RUFUS KING POLK, B.S.

"Discussion and Calculations for an Hydraulic Crane."

WILLIAM RICHARD SATTLER, M.E.

"A determination of the best method for the treatment of Cerro de Pasco Silver ore, with an account of the mines."

THEODORE STEVENS, B.M.

"A Review of the Lykens' Valley Electric Motor."

HARRY HARKNESS STOEK, B.S.

"On the Classification and Determination of the Plagioclases, with Special Reference to Szabo's Method, and the Optical Examination according to Max Shuster."

HENRY AUGUSTUS JULIUS WILKINS, B.S.

"Bessemer Converter Linings."

FRANK WILLIAMS, B.S.

UNIVERSITY DAY.

This day is the last of the academic year and falls in 1889 on the third Thursday in June. On this day orations are delivered by members of the Graduating Class, and Degrees are conferred.

EXERCISES ON JUNE 21, 1888.

Reading of Scripture and Prayer by the Rt. Rev. M. A. de Wolfe Howe, D.D., LL.D., Bishop of the Diocese.

Salutatory Oration.—"A Lesson from Rip Van Winkle."

ALBERT GEORGE RAU.

Oration.—"Our Twin Curses of Idleness and Overwork."

JAMES BOLAN GLOVER.

Oration.—"Competition."

ROBERT BROWNE HONEYMAN.

Oration.—"The Philosopher's Stone."

HARLAN SHERMAN MINER.

Valedictory Oration.

SAMUEL WILSON FRESCOLN.

Award of the Wilbur Scholarship to

AARON HOWELL VAN CLEVE

of Easton, Pa., first in rank in the Sophomore Class.

The Wilbur Prizes were awarded as follows:

Sophomore Class, Modern Languages,

GEORGE EDWARD WENDLE.

Freshman Class, Mathematics,

WALTER FORSTALL,
DOMINGO ANTHONY USINA,
ROBERT SCHMITZ.

Freshman Class, Free Hand Drawing,

BENJAMIN WILLIAM HOMANS,
JOHN ZOLLINGER MILLER.

Award of Certificates for the Advanced Course in Electricity.

The following degrees were conferred:

B.S.

CHARLES LINCOLN BANKS,
WILLIAM LYNVILLE NEILL,
ALBERT GEORGE RAU.

C.E.

Edmund A. Bates,
William Donaldson Beatty,
Hubert Alexander Bonzano,
William Bradford,
Charles Noble Butler,
Morton Lewis Byers,
George Philip Connard,
Reuben Daniels,
George Herschel Davis,
William Schaff Davis,
Philip Hoffecker DeWitt,
Manuel Victor Domenech,
Charles Wesley Focht,
Samuel Wilson Frescoln,
William Gates, Jr.,
Sterry Henry Jencks,
James Struthers Mack,
Howard Hale McClintic,
Charles Donnell Marshall,
Charles Henry Miller,
George Philips Miller,
John Hoff Millholland,
Harry Palmer,
Charles Jeremiah Parker,
Clarence Elmer Raynor,
William Pemberton Richards,
Osmond Rickert,
Eugene Hicks Shipman,
Harvey Musser Wetzel,
Winter Lincoln Wilson,
Edward Benjamin Wiseman,
Shuntaro Yamaguchi,
Luther Reese Zollinger.

M.E.

Charles Lambert Addison,
George Reade Baldwin,
Adolph Theodore Bruegel,
John Jesse Clark,

GEORGE PATTERSON DRAVO,
FRANCIS ROUAD DRAVO,
GEORGE STEINMAN FRANKLIN,
JAMES BOLAN GLOVER,
HUGHLETT HARDCASTLE,
GEORGE AUGUSTUS HART,
WALTER ASHFIELD MCFARLAND,
HARRY SEMPLE MORROW,
WILLIAM ALONZO STEVENSON,
WILMER MARSHALL WEBB.

B.S.

(In Mining and Metallurgy.)

LOUIS PREVOST GASTON,
ROBERT BROWNE HONEYMAN,
ALFRED ELI LEWIS, JR.,
FRANCIS WILLIAM BIRCHAL PILE,
WYNDHAM HARVEY STOKES.

A.C.

FREDERICK HAYES KNORR,
HOWARD LEOSER MCILVAIN,
HARLAN SHERMAN MINER.
HOWARD SEGAR NEIMAN,
ROBERT SWAIN PERRY.

E.M.

ROBERT WEBB BARRELL, B. M.,
HENRY BENJ. CHAS. NITZE, B. S.,
FRANCIS WILLIAM BURCHAL PILE, B.S.
RUFUS KING POLK, B. S.,
THEODORE STEVENS, B. M.,
HARRY HARKNESS STOEK, B. S.,
HENRY AUG. JULIUS WILKENS, B. S.,
FRANK WILLIAMS, B. S.

The Benediction was then pronounced by the Bishop.

THE WILBUR SCHOLARSHIP.

This Scholarship was founded in 1872 by E. P. Wilbur, Esq., of South Bethlehem, and is the sum of $200 awarded annually to the student in the Sophomore Class having the best record.

THE ALUMNI SCHOLARSHIP.

The Alumni Association of the University has established a Scholarship of the value of $250 per annum, subject to the following conditions:

1. That the Scholarship shall only be awarded to a student really in need of it.

2. That the Scholarship shall not apply to the first year of any student's course; he must without this aid have gone through one year, and must be prepared to start the second year free from all conditions.

3. That the Scholarship shall not be continued to a student who shall at any time during his course carry any condition over eight weeks beyond the date of the examination in which he failed.

Subject only to the above conditions the disposal of the fund shall until otherwise directed be in the hands of the President of the University.

WILBUR PRIZE.

By the generosity of E. P. Wilbur, Esq., a fund has been established yielding an annual income of $100, for distribution in prizes as the Faculty shall determine.

ALUMNI PRIZES FOR ORATORY.

The "Alumni Association of the Lehigh University" has established an Annual Sum of Fifty Dollars, to be distributed as prizes for excellence in Oratory, subject to the following

REGULATIONS.

1. The Contest shall be held on the 22d day of February, or on the day designated by the University to commemorate the birthday of Washington.

2. There shall be a first prize of $25, a second of $15, and a third of $10.

3. To entitle one to be a competitor he must be a member of the Junior Class, taking a regular course.

4. Subjects for the oration shall be announced at the beginning of the first Term of every year and upon one of these, each competitor shall write an oration not to exceed eight minutes in delivery.

5. Each oration shall bear upon its first page a fictitious name or motto, and shall be accompanied by a sealed envelope, which shall be superscribed with the same name or motto, and an address by which it may be reclaimed. The envelope shall contain the real name and address of the writer, with the declaration that the oration is his own original work. The examiner, having adopted a standard of excellence, may reject any or all of the orations presented which do not attain to this standard; of such as do —should they be sufficient in number—the best six shall be chosen, and their envelopes opened. The others shall be returned to the address given with their envelopes unopened.

6. The Executive Committee of the Alumni Association, or a committee of not fewer than three to be appointed by them, shall hear the competitors, whose oration shall have been approved, and the awards shall be made by a majority of these Judges.

7. In awarding the prizes the judges shall consider both the literary merits and the delivery of each oration.

8. These rules are subject to amendment by the Faculty.

At the last contest, the First Prize was awarded to

WILLIAM DOLLOWAY FARWELL,

the Second, to

PEARCE ATKINSON,

and the Third, to

JOHN THOMAS MORROW.

The next contest will take place February 22, 1889.

ENTRANCE EXAMINATION PAPERS.

Used at the Examination in 1888.

[Requests for other examination papers than those herein printed can not be granted.]

I.—ENGLISH GRAMMAR.

1. When are words said to be "*derivative*" and when "*compound?*" Give examples of each.

2. What classes of words are compared? Give examples of the regular comparison of words both by prefixes and suffixes; also, of irregular comparison, and of words of the same classes which do not admit of comparison.

3. What are the names of the different classes of pronouns?

4. What particular pronouns are varied in form to denote gender?

5. Write sentences in which the relative *who*, *which*, *what* and *that* are properly used.

6. What is meant by *case* in nouns and pronouns?

7. What *properties* (or *modifications*, *attributes*, etc.,) have verbs?

8. What is *mood? tense?*

9. What moods can not be used in interrogative sentences?

10. What tenses can be formed without auxiliaries?

11. Give the second person singular of the verb *be* in the several moods and tenses.

12. What class of verbs admit of the passive form, and of which principal part and which auxiliary verb is this form constructed? Give the first person singular passive of the verb *see*, in each of the moods and tenses.

13. What are the principal parts of the following verbs: *lay*, *lie*, *lead*, *make*, *ride*, *see*, *swim*, *write?*

14. Of what does syntax treat?

15. In the clause, "*If it be proved against an alien*," etc., in what mood is the verb, and why?

16. Parse "*only*" in the phrase, "*Of the duke only.*"

17. What is the principal or leading clause in the sentence, "*In which predicament I say thou stand'st.*"

18. Parse "*which*" in the same sentence.

19. Give the principal parts of "*say*" and "*stand'st.*"

20. Parse the verb in "*Thou hast incurred the danger*," giving the voice mood, tense, person, number, subject, and rule of syntax.

21. Change the quotation in question number 20 to the *passive* form.

22. Parse "*down*" in the sentence, "*Down, therefore, and beg mercy of the duke*," giving particulars required in question number 20.

23. In what case is "*mercy*," and why?

24. Parse "*therefore.*"

II.—GEOGRAPHY.

1. Give the courses of the following rivers and the States through, or on the border of which they flow: Connecticut, Arkansas, and Tennessee.

2. Bound Georgia, New York, Colorado, and give the capital, principal rivers and mountains of each.

3. In what States and where are the following: Austin, Baton Rouge, Olympia, and Augusta?

4. Through what States would a straight line from Salem, Oregon, to Key West, Florida, pass?

5. Name and locate the Capitals of Illinois, Mississippi, Florida, North Carolina, and Rhode Island?

6. Through what waters would you sail westward from San Francisco to New York, *via* Singapore and the Cape of Good Hope?

7. Name and locate the principal cities of Hungary, Saxony, China, New South Wales, and Scotland.

8. Bound the following: Mexico, Peru, Italy, Persia, and Siberia.

9. Locate the following: Copenhagen, Glasgow, Moscow, Alexandria, and Bombay.

10. Locate the Euphrates, Isthmus of Corinth, North Sea, Don, and Straits of Gibralter.

III.—UNITED STATES HISTORY.

1. Give the leading events in the early history of New York.

2. When and where did the second continental congress meet, what were its principal dispositions in behalf of the army and navy? Give the names of some of the most distinguished men of that body.

3. When and where did the federal convention meet? Who presided over it? What were the results?

4. Give the leading events, domestic and foreign, of the two terms of Monroe's administration.

5. What were the provisions of the Fugitive-Slave Law? What was its worst provision? What its effect?

6. What was the federal policy? What was the condition of the South at Lincoln's inauguration?

7. What were the leading events during the second term of Grant's administration?

8. How are disputed elections decided? May any of the proceedings of Congress be kept secret? May either branch adjourn without the consent of the other?

9. How are the States protected?

10. Who has power to enforce the XIVth amendment?

IV.—ARITHMETIC.

1. (*a*) Give definition of an integer; a prime number; a prime factor.

(*b*) What is the greatest common divisor of two numbers? The least common multiple?

(*c*) Explain process of subtracting fractions; of reducing a common fraction to a decimal; of reducing a decimal to a common fraction.

2. (*a*) Give number of square rods in an acre; number of cubic feet in a cord of wood; number of pints in a dekalitre.

(*b*) What is percentage? What are discount and bank discount? What is real estate?

(*c*) What is ratio? What is a proportion? What are the assets and liabilities of a firm?

3. $[2 . \frac{3}{5} - 1.019 + \frac{8}{25}] \div [516.04 - \frac{7}{25} + .002]$ Reduce to decimal, and explain rule for position of decimal point.

4. If distance from the Sun Hotel to Packer Hall is $1\frac{1}{4}$ miles, what is the number of kilometres? Of centimetres?

5. Find interest, discount, and bank discount on \$416.03 for 60 days, at $7\frac{1}{2}$ %.

6. A miller mixes 18 bushels of wheat at \$1.44 with 6 bushels at \$1.32, 6 bushels at \$1.08, 12 bushels at \$0.84. What will be his gain per bushel if he sells the mixture at \$1.50?

7. A square field contains 1,016,064 sq. feet. What is the length of a side expressed in metres?

V.—GEOMETRY.

1. (*a*) Define an angle; a right angle; an oblique angle; a straight line.

(*b*) Define a plane; diedral angle; plane-angle of diedral angle; convex polyedral angle.

(*c*) Define a geometric locus, and give three examples of loci.

2. (*a*) Define similar polygons; a regular polygon. State relation of areas of similar polygons.

(*b*) Under what conditions will two triangles be similar? Under what conditions will they be equal?

(*c*) State the various conditions under which a quadrilateral is a parallelogram.

3. Two triangles are equal when the three sides of the one are respectively equal to the three sides of the other.

4. The medial lines of a triangle meet in a point.

5. At a given point on the circumference to draw a tan-

gent to the circle. From a given point without to draw a tangent to a circle.

6. If through a fixed point in the plane of a circle a chord is drawn, the product of its two segments is the same regardless of its direction.

7. Show how to construct a polygon similar to a given polygon and having two-thirds its area.

8. Of all isoperimetric polygons having the same number of sides the regular polygon is a maximum.

9. If a straight line is perpendicular to each of two lines at their intersection it is perpendicular to their plane.

10. The acute angle which a line makes with its own projection on a plane is the least angle which it makes with any line of the plane.

VI.—ALGEBRA.

1. (*a*) Give definitions of quantity ; mathematics ; algebra.

(*b*) What are factors? What is a monomial? A polynomial?

(*c*) What is the reciprocal of a quantity? What is the reciprocal of zero?

2. (*a*) Explain process of dividing one polynomial by another.

(*b*) What is a prime quantity? What is the least common multiple of two or more quantities?

3. (*a*) What is the degree of an equation? What is an identical equation.

(*b*) Explain process of elimination by comparison.

(*c*) Show that every equation of the second degree containing only one unknown quantity can be reduced to the form $x^2 + px = q$.

4. Reduce the following fractions to their simplest form :

$$\frac{4ax}{3by} \times \frac{a^2 - x^2}{c^2 - x^2} \times \frac{bc + bx}{a^2 - ax},$$

$$\frac{a + b + \dfrac{b^2}{a}}{a + b + \dfrac{a^2}{b}}.$$

5. Solve the following equations:

$$\frac{1}{x} + \frac{1}{2x} - \frac{1}{3x} = \frac{7}{3}, \qquad \frac{x}{a} - 1 - \frac{dx}{c} + 3ab = 0.$$

6. The hour and minute hand of a clock are together at noon; when are they next together?

7. Solve the following equations:

$$\left\{\begin{array}{l} \frac{1}{3}(x+y) + \frac{1}{4}(x-y) = 59, \\ 5x - 33y = 0. \end{array}\right. \qquad \left\{\begin{array}{l} \frac{1}{x} + \frac{1}{y} = a. \\ \frac{1}{x} + \frac{1}{z} = b. \\ \frac{1}{y} + \frac{1}{z} = c. \end{array}\right.$$

8. Reduce to the following equivalent expressions having rational denominators:

$$\frac{8 - 5\sqrt{2}}{3 - 2\sqrt{2}}, \quad \frac{1}{x + \sqrt{x^2 - 1}} + \frac{1}{x - \sqrt{x^2 - 1}}, \quad \frac{a + b\sqrt{-1}}{a - b\sqrt{-1}}$$

9. Solve the following equations:

$$\sqrt{2x - 3a} + \sqrt{2x} = 3\sqrt{a}, \qquad \frac{x}{a} + \frac{a}{x} - \frac{2}{a} = 0.$$

10. Solve the following equations:

$$\left.\begin{array}{r} x^{\frac{2}{3}} + x^{\frac{1}{3}} = 1056, \\ (x-2)(x+\frac{1}{2})(x-a) = 0, \end{array}\right. \qquad \left\{\begin{array}{l} x(y+z) = a \\ y(x+z) = b \\ z(x+y) = c \end{array}\right\}.$$

VII —PHYSICS.

NOTE.—*The examination in Physics must be passed in June or September of that year in which the candidate proposes to enter the University.*

1. Define (*a*) Energy.
   (*b*) Coefficient of expansion.
   (*c*) Erg.
   (*d*) Index of refraction.
   (*e*) Watt.
2. Give the laws of motion.

3. What weight can be lifted with a screw whose threads are $\frac{1}{4}$ inch apart, by a power of 100 pounds applied at the end of a lever which describes a circumference of 10 feet?

4. What is the ratio between the quantities of heat which are respectively produced, when a bullet weighing 50 grammes and having a velocity of 500 metres, and a cannon ball weighing 40 kilogrammes with a velocity of 400 metres, strike a target?

5. How much lead at 100° C. (the specific heat of which is 0.0314) is required to melt 10 pounds of ice at 0° C. and raise the temperature of the water to 20° C.?

6. A volume of gas measures 969 cubic inches at 25° C. and at a barometric pressure of 30 inches; what will be its volume if the temperature is raised to 50° C. and the barometric pressure changes to 31 inches?

7. If the object is 10 inches from a convex lens and the screen when the image is sharply defined on it, is 80 inches from the lens, what is the focal length of the lens?

8. Describe a secondary or storage battery.

9. What is meant by the extra current in an induction coil?

10. If a battery with a difference of potential of 12 volts should give a current strength of 0.6 amperes, what must be the internal resistance of the battery, there being no appreciable external resistance?

11. Explain (*a*) Unit strength of magnetic pole.
(*b*) Unit difference of magnetic potential.
(*c*) Intensity of magnetic field.
(*d*) Unit strength of current.
(*e*) Unit of resistance.

VIII.—LATIN.

I.—GRAMMAR.

1. Decline the following nouns, marking the quantity of the penultimate and final syllables through all the cases; *ala*, *genius*, *pars*, *conclave*, *acus*, *acies*. Give the gender of each noun, with rule for it.

2. Decline the adjectives *acer* and *facilis*; the pronouns *quidam* and *uter*. Compare *acer*, *facilis*, *felix*, *malus*. Form adverbs from *pulcher* and *prudens*, and compare them. How do you express in Latin *five*, *fifth*, and *five times?*

3. Give the principal parts of the following verbs, marking the quantity of all the syllables: *sto*, *torqueo*, *cado*, *cædo*, *cedo*, *ordior*. Inflect the Perfect Subjunctive Active of *cedo*, and the Present Imperative Passive of *ordior*, marking the quantities throughout.

4. What case or cases follow *pudet*, *fungor*, *præsum*, *doceo?* Translate into Latin: 1. He asked (*rogo*) him whether (*num*) Caius had come (*venio*). 2. He said (*dico*) that Caius would come. 3. He orders (*impero*) Caius to come. 4. He was hindered (*impedio*) by Caius from (*quominus*) coming. 5. He was waiting (*opperior*) until (*dum*) Caius should come. 5. No one (*nemo*) waited who was able (*possum*) to come. 7. If he had waited, I should not have come. 8. Would that (*utinam*) Caius would come. 9. Do not come, Caius.

5. State where each of the following forms is made, and give the principal parts of the verb to which it belongs: *usserit*, *vetaberis*, *texitis*, *sprevissent*, *vinxeram*, *vīdēris*, *vīdēris*. Form the III. S. Fut. Pf. Ind. Act. of *parĕre;* II. P. Perf. Ind. Act. of *gignere;* II. P. Fut. Ind. Pass. of *capere;* I. S. Pres. Subj. Pass. of *vocare;* III. P. Imp. Subj. Pass. of *oblivisci;* III. P. Fut. Imperat. Pass. of *haurire;* the Fut. Inf. Pass. of *premere;* the Fut. Part. Pass. of *mittere*. Give a synopsis of *patior*. Inflect the active voice of *fero* throughout.

II.—CAESAR.

Translate:

1. Milites non longiore oratione cohortatus quam uti suæ pristinæ virtutis memoriam retinerent neu perturbarentur animo hostiumque impetum fortiter sustinerent, quod non longius hostes aberant quem quo telum adjici posset, prœlii committendi signum dedit. Atque in alteram partem item cohortandi causa profectus pugnantibus occurrit. Temporis tanta fuit exiguitas hostiumque tam paratus ad dimicandum

animus, ut non modo ad insignia accommodanda, sed etiam ad galeas induendas scutisque tegimenta detrudenda tempus defuerit.—*B. G. II.*

2. Quo prœlio bellum Venetorum totiusque oræ maritimæ confectum est. Nam quum omnis juventus, omnes etiam gravioris ætatis, in quibus aliquid consilii aut dignitatis fuit, eo convenerant, tum navium quod ubique fuerat in unum locum coegerant; quibus amissis reliqui neque quo se reciperent neque quemadmodum oppida defenderent habebant. Itaque se suaque omnia Cæsari dediderunt. In quos eo gravius Cæsar vindicandum statuit, quo diligentius in reliquum tempus a barbaris jus legatorum conservaretur Itaque omni senatu necato reliquos sub corona vendidit.—*B. G. III.*

III.—CICERO.

Translate:

1. Tertium genus est ætate jam affectum, sed tamen exercitatione robustum, quo ex genere iste est Manlius, cui nunc Catilina succedit: sunt homines ex eis coloniis, quas Sulla constituit; quas ego universas civium esse optimorum et fortissimorum virorum sentio, sed tamen ii sunt coloni, qui se in insperatis ac repentinis pecuniis sumptuosius insolentiusque jactarunt. Hi dum ædificant tamquam beati, dum prædiis lectis, familiis magnis, conviviis apparatis delectantur, in tantum æs alienum inciderunt, ut si salvi esse velint, Sulla sit eis ab inferis excitandus.—*In Catilinam, II.* 9.

2. Quod si omnis impetus domesticorum hostium, depulsus a vobis, se in me unum convertit, vobis erit videndum, Quirites, qua condicione posthac eos esse velitis, qui se pro salute vestra obtulerint invidiae periculisque omnibus; mihi quidem ipsi quid est quod jam ad vitae fructum possit adquiri, cum praesertim neque in honore vestro neque in gloria virtutis quidquam videam altius, quo mihi libeat ascendere? - *In Catilinam, III*, 12.

Vobis, condicione, velitis, obtulerint, possit, videam. What does Cicero mean by *Neque in honore vestro quidquam videam altius?*

IV.—VIRGIL.

Translate:

I. *C.* Muscosi fontes et somno mollior herba,
Et quæ vos rara viridis tegit arbutus umbra,
Solstitium pecori defendite: iam venit æstas
Torrida, iam læto turgent in palmite gemmæ.
T. Hic focus et tædæ pingues, hic plurimus ignis
Semper, et adsidua postes fuligine nigri;
Hic tantum Boreæ curamus frigora, quantum
Aut numerum lupus, aut torrentia flumina ripas.
Ecl. VII., 45–52.

II. Postera iamque dies primo surgebat Eoo,
Humentemque Aurora polo dimoverat umbram:
Cum subito e silvis, macie confecto suprema,
Ignoti nova forma viri miserandaque cultu
Procedit supplexque manus ad litora tendit.
Respicimus. Dira inluvies inmissaque barba,
Consertum tegumen spinis; at cetera Graius,
Et quondam patriis ad Troiam missus in armis.
Æn. III.

III. Anna, vides toto properari litore? Circum
Undique convenere; vocat iam carbasus auras,
Puppibus et læti nautæ inposuere coronas.
Hunc ego si potui tantum sperare dolorem,
Et perferre, soror, potero. Miseræ hoc tamen unum
Exsequere, Anna, mihi; solam nam perfidus ille
Te colere, arcanos etiam tibi credere sensus;
Sola viri mollis aditus et tempora noras;
I, soror, atque hostem supplex adfare superbum;
Æn. IV., 416–424.

V.—SIGHT READING.

Translate:

1. Civitatibus maxima laus est quam latissime circum se vastatis finibus solitudines habere. Hoc proprium virtutis existimant, expulsos agris finitimos cedere neque quemquam prope audere consistere: simul hoc se fore tutiores arbitrantur repentinæ incursionis timore sublato. Quum bellum

civitas aut illatum defendit aut infert, magistratus qui ei bello præsint ut vitæ necisque habeant potestatem deliguntur. In pace nullus est communis magistratus, sed principes regionum atque pagorum inter suos jus dicunt controversiasque minuunt.—*Caesar, B. G., VI.*

2. Vixerat M'. Curius cum P. Decio, qui quinquennio ante consulem se pro re publica quarto consulatu devoverat; norat eundem Fabricius, norat Coruncanius: qui quum ex sua vita tum ex eius, quem dico, Decii facto iudicabant esse profecto aliquid natura pulcrum atque præclarum quod sua sponte peteretur quodque spreta et contempta voluptate optimus quisque sequeretur.—*Cato Major, XIII*, 43.

VI.—COMPOSITION.

Write in Latin:

1. When[1] the enemy[2] saw[3] that the damages,[4] which they had hoped[5] could[6] not be repaired[7] for a long[8] time,[9] had been so[10] repaired by the toil[11] of a few[12] days[13] that there was no opportunity[14] left[15] for a sally,[16] they were eager[17] for the original[18] terms[19] of capitulation.[20].

1. Ubi. 2. Hostis. 3. Video. 4. Is. 5. Spero. 6. Possum. 7. Reficio. 8. Longus. 9. Spatium. 10. Ita. 11. Labor. 12. Paucus. 13. Dies. 14. Locus. 15. Relinquo. 16. Eruptio. 17. Recurro. 18. Idem. 19. Conditio. 20. Deditio.

VII.—HISTORY.

1. The life of C. Julius Caesar.
2. Laws that are landmarks in Roman History.
3. Mention any reasons that occur to you (1) why Hannibal should have hoped to overcome Rome; and (2) why he failed in his attempt.
4. Give a brief account (with the important dates) of the political career either of Cicero or of Augustus, at your option.
5. Mention the names of the emperors between Domitian and Commodus, in the order of their reigns.

IX.—GREEK.

I.—GRAMMAR.

1. Give the indefinite, demonstrative, and relative adverbs corresponding to the interrogatives *πότε* and *πόθεν*.

2. What is the quantity of the ultima in *σῶμα*, *χώρα*, *ἄνθρωποι*, *ἀγγέλλοι*, and of the penult in *κρῖνε*? What shows in each case, and on what rules?

3. Decline, through all numbers, *δόξα*, *ὁδός*, *πατήρ*, *πόλις*.

4. Compare the adjectives *μέγας*, *ἡδύς*, *σοφός*, the adverb *μάλα*.

5. Give the synopsis (*i. e.*, first form in each mode) of the perfect middle, first aorist active, and future active of *φαίνω*. Inflect through the numbers and persons the imperfect active and middle of *τίθημι*, the aorist subjunctive passive of *λύω*.

6. Analyze *λύσουσι*.

7. What prepositions are used with one case only, and with what case respectively?

II.—XENOPHON.

1. Translate:

ἀλλ' ἐγὼ φημι ταῦτα μὲν φλυαρίας εἶναι· δοκεῖ δέ μοι ἄνδρας ἐλθόντας πρὸς Κῦρον οἵτινες ἐπιτήδειοι σὺν Κλεάρχῳ ἐρωτᾶν ἐκεῖνον τί βούλεται ἡμῖν χρῆσθαι· καὶ ἐὰν μὲν ἡ πρᾶξις ᾖ παραπλησία οἵαπερ καὶ πρόσθεν ἐχρῆτο τοῖς ξένοις, ἕπεσθαι καὶ ἡμᾶς καὶ μὴ κακίους εἶναι τῶν πρόσθεν τούτῳ συναναβάντων· ἐὰν δὲ μείζων ἡ πρᾶξις τῆς πρόσθεν φαίνηται, ἀξιοῦν ἢ πείσαντα ἡμᾶς ἄγειν ἢ πεισθέντα πρὸς φιλιαν ἀπιέναι.—(An. I. 3, 18.)

Construction of *οἵαπερ* and of *πεισθέντα*. On what does *ἕπεσθαι* depend?

2. Translate:

ταῦτα οὖν φιλοπολέμου μοι δοκεῖ ἀνδρὸς ἔργα εἶναι, ὅστις ἐξὸν μὲν εἰρήνην ἔχειν ἄνευ αἰσχύνης

καὶ βλάβης αἱρεῖται πολεμεῖν, ἐξὸν δὲ χρήματα ἔχειν ἀκινδύνως αἱρεῖται πολεμῶν μείονα ταῦτα ποιεῖν· ἐκεῖνος δὲ ὥσπερ εἰς παιδικὰ ἢ εἰς ἄλλην τινὰ ἡδονὴν ἤθελε δαπανᾶν εἰς πόλεμον.—(An. II.6,6.)

Construction of ἐξόν. Of whom is this character given?

3. Translate:

τοῦτο δὲ λέγοντος αὐτοῦ πτάρνυταί τις· ἀκούσαντες δ' οἱ στρατιῶται πάντες μιᾷ ὁρμῇ προσεκύνησαν τὸν θεόν, καὶ Ξενοφῶν εἶπε, Δοκεῖ μοι, ὦ ἄνδρες, ἐπεὶ περὶ σωτηρίας ἡμῶν λεγόντων, οἰωνὸς τοῦ Διὸς τοῦ σωτῆρος ἐφάνη, εὔξασθαι τῷ θεῷ τούτῳ θύσειν σωτήρια ὅπου ἂν πρῶτον εἰς φιλίαν χώραν ἀφικώμεθα, συνεπεύξασθαι δὲ καὶ τοῖς ἄλλοις θεοῖς θύσειν κατὰ δύναμιν. καὶ ὅτῳ δοκεῖ ταῦτ', ἔφη, ἀνατεινάτω τὴν χεῖρα. καὶ ἀνέτειναν ἅπαντες. ἐκ τούτου εὔξαντο καὶ ἐπαιάνισαν.

—(An. III. 2, 9.)

Reason for the subjunctive in ἀφικώμεθα. Construction of ἡμῶν. Construction of the antecedent of ὅτῳ.

4. Translate:

ἐντεῦθεν ἔπεμψαν νυκτὸς Δημοκράτην Τεμενίτην ἄνδρας δόντες ἐπὶ τὰ ὄρη, ἔνθα ἔφασαν οἱ ἀποσκεδαννύμενοι καθορᾶν τὰ πυρά· οὗτος γὰρ ἐδόκει καὶ πρότερον πολλὰ ἤδη ἀληθεῦσαι τοιαῦτα, τά ὄντα τε ὡς ὄντα καὶ τὰ μὴ ὄντα ὡς οὐκ ὄντα. πορευθεὶς δὲ τὰ μὲν πυρὰ οὐκ ἔφη ἰδεῖν, ἄνδρα δὲ συλλαβὼν ἦκεν ἄγων ἔχοντα τόξον Περσικὸν καὶ φαρέτραν καὶ σάγαριν, οἵανπερ αἱ Ἀμαζόνες ἔχουσιν. ἐρωτώμενος δὲ τὸ ποδαπὸς εἴη, Πέρσης μὲν ἔφη εἶναι, πορεύεσθαι δ' ἀπὸ τοῦ Τιριβάζου στρατεύματος, ὅπως ἐπιτήδεια λάβοι.—(An. IV. 4, 15.)

Construction of νυκτός. To what does τό belong? Reason for the optative in εἴη and in λάβοι.

III.—HOMER.

1. Translate:

"Ὦ πόποι, ἦ μέγα πένθος Ἀχαιΐδα γαῖαν ἱκάνει.
ἦ κεν γηθήσαι Πρίαμος Πριάμοιό τε παῖδες,
ἄλλοι τε Τρῶες μέγα κεν κεχαροίατο θυμῷ,
εἰ σφῶϊν τάδε πάντα πυθοίατο μαρναμένοιιν,
οἳ περὶ μὲν βουλὴν Δαναῶν, περὶ δ' ἐστὲ μάχεσθαι."
—(Il. I. 254–258.)

Make a list of the forms in these lines peculiar to Homer, adding, in each case, the corresponding Attic form.

Explain the form *κεχαροίατο*.

2. Translate:

"πῇ δὴ συνθεσίαι τε καὶ ὅρκια βήσεται ἡμῖν;
ἐν πυρὶ δὴ βουλαί τε γενοίατο μήδεά τ' ἀνδρῶν,
σπονδαί τ' ἄκρητοι καὶ δεξιαί, ἧς ἐπέπιθμεν·
αὖτως γάρ β' ἐπέεσσ' ἐριδαίνομεν, οὐδέ τι μῆχος
εὑρέμεναι δυνάμεσθα, πολὺν χρόνον ἐνθὰδ' ἐόντες."
—(Il. II. 339–343.)

Where is *ἐπέπιθμεν* made? What is the derivation of *σπονδαί*? the reason for the gender of *δεξιαί*? What other forms in Homer of *ἐπέεσσι*? What length of time denoted by *πολὺν χρόνον*?

3. Translate:

ὣς ἄρ' ἔφαν, πάλλεν δὲ μέγας κορυθαίολος Ἕκτωρ
ἀψ ὁρόων· Πάριος δὲ θοῶς ἐκ κλῆρος ὄρουσεν.
οἱ μὲν ἔπειθ' ἵζοντο κατὰ στίχας ἦχι ἑκάστου
ἵπποι ἀερσίποδες καὶ ποικίλα τεύχε' ἔκειτο·
αὐτάρ ὅ γ' ἀμφ' ὤμοισιν ἐδύσετο τεύχεα καλὰ
δῖος Ἀλέξανδρος, Ἑλένης πόσις ἠυκόμοιο.
ὣς δ' αὖτως Μενέλαος ἀρήιος ἔντε' ἔδυνεν.
—(Il. III. 324–329, 339.)

What was determined by the process described in the first two lines? Why are the words *ἀψ ὁρόων* added? What was the issue of the combat that followed?

IV.—SIGHT READING.

ἐπεὶ δὲ μέγα φρονήσας ὁ Τισσαφέρνης ἐπὶ τῷ καταβάντι στρατεύματι παρὰ βασιλέως προεῖπεν Ἀγησιλάῳ πολεμον, εἰ μὴ ἀπίοι ἐκ τῆς Ἀσίας, οἱ μὲν ἄλλοι σύμμαχοι καὶ Λακεδαιμονίων οἱ παρόντες μάλα ἀχθεσθέντες φανεροὶ ἐγένοντο, Ἀγησίλαος δὲ μάλα φαιδρῷ τῷ προσώπῳ ἀπαγγεῖλαι Τισσαφέρνει τοὺς πρέσβεις ἐκέλευσεν ὡς πολλὴν χάριν αὐτῷ ἔχοι, ὅτι ἐπιορκήσας αὐτὸς μὲν πολεμίους τοὺς θεοὺς ἐκτήσατο τοῖς δ' Ἕλλησι συμμάχους ἐποίησεν. ἐκ δὲ τούτου εὐθὺς τοῖς μὲν στρατιώταις παρήγγειλε συσκευάζεσθαι ὡς εἰς στρατείαν, ταῖς δὲ πόλεσιν εἰς ἃς ἀνάγκη ἦν ἀφικνεῖσθαι στρατευομένῳ ἐπὶ Καρίαν προεῖπεν ἀγορὰν παρασκευάζειν.

V.—HISTORY.

1. Give a brief account of Demaratos (the friend of Xerxes); of Brasidas; of Pelopidas.

2. Mention any events you recall between the Persian and Peloponnesian wars.

3. Describe the formation of the first Athenian confederacy and the process of its change into an empire.

4. Describe *ostracism*. Against what individuals is it known to have been put into effect?

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*Carl F. Zogbaum, C.E.

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CLASS OF 1877.

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CLASS OF 1884.

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Edwin Franklin Hofford, C.E., Lehighton, Pa.

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CLASS OF 1887.

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CLASS OF 1888.

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The number of Graduates is 314, of whom 22 have taken the Degree of B.A.; 7 of Ph.B.; 15 of B.S.; 5 of B.M.; 129 of C.E.; 67 of M.E.; 22 of E.M.; 28 of A.C.; 1 who has taken both B.A. and E.M.; 1 both B.A. and M.A.; 1 both B.S. and C.E.; 1 both C.E. and E.M.; 2 both A.C. and E.M.; 7 both B.S. and E.M.; 5 both B.M. and E.M., and 1 who has taken B.M., E.M., and A.C.

The following have been awarded certificates for the

ADVANCED COURSE IN ELECTRICITY.

CLASS OF 1885.

Elmer Ellsworth Boyer, Foreman Arc Testing Department, Thompson-Houston Electric Co., Lynn, Mass.
Horace Musser Engle, Marietta, Pa.
Charles Leavitt Jenness, Western Electric Co., Chicago, Ill.
George Herman Koehler, Standard Underground Cable Co., Pittsburgh, Pa.
George Herbert Putnam, Instructor in Minnesota School for the Deaf, Faribault, Minn.
Lewis Buckley Stillwell, Assistant Electrician, Westinghouse Electric Co., Pittsburgh, Pa.

CLASS OF 1886.

Edward Conner, Philadelphia, Pa.
James Arthur Heaton, Boston, Mass.
William Hoopes, Superintendent Edison Electric Co.'s Station, West Chester, Pa.
Walter Eugene Hyer, Thompson-Houston Electric Co., Newburyport, Mass.
Robert McAllister Loyd, Assistant Electrician, Daft Electric Co., Marion, New Jersey.
George Harrison Neilson, Construction Dept. Pennsylvania R. R., 1105 Eutaw St., Baltimore, Md.
Charles Jacob Meade, Edison Electric Illuminating Co. of New York, 348 W. 20th Street, New York City.

CLASS OF 1887.

Walter George Fuller, Brattleboro, Vermont.
John Wesley Hackney, Graphic Process Co., Pleasantville, N. J.
William Sigler Jones, Wharton Railroad Switch Co., 7 East Penn Street, Germantown, Pa.

Dion M. Martinez, jr., Reading R. R. Co., Philipsburg, Centre Co., Pa.

Horace Fields Parshall, Electrician of Sprague Electric R. W. and Motor Co., 510 W. 30th Street, New York City.

Arthur Douglas Spear, Brush Electric Co., Cleveland, Ohio.

George Henry Wolle, Electrical Accumulator Co., 44 Broadway, New York City.

CLASS OF 1888.

Albert Brodhead, Lehigh University, 121 S. Center Street, Bethlehem, Pa.

William Fairchild Dean, Thompson-Houston Electric Co., 91 Warren Street, Lynn, Mass.

Herman Frauenthal, Wilkes-Barre, Pa.

Richard Otto Albert Heinrich, Philosophical Department, J. W. Queen & Co.

Joseph Allison Horner, Brush Electric Light Co., Phila., Pa.

William Henry Hubbard, Superintendent of The Beaver Valley Electric Light and Power Co., Beaver Falls, Pa.

Daniel Henry Jenkins, Mutual Electric and Accumulator Co., 76 Ashland Place, Brooklyn, N. Y.

Charles Jacob Miller, Brush Electric Light Co., 720 N. 5th Street, Philadelphia, Pa.,

James Leidy Moore, Thompson-Houston Electric Co., Lynn, Mass.

Charles Norris Robinson, Wynkoop & Robinson, Manufacturers of Artificial Stone, 4948 Main Street, Germantown, Pa.

Harry Meyer Seitzinger, Germantown, Pa.

Charles Wesley White, Excelsior Electric Co., Brooklyn, N. Y.

Hugh Carlyle Young, Testing Department, Edison Machine Works, 224 Union Street Schenectady, N. Y.

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*Milton Dimmick, '70.

E. Warren Sturdevant, '75, Att'y-at-Law, Wilkes-Barre, Pa.

* Deceased.

LIST OF DONATIONS

TO THE

VARIOUS DEPARTMENTS

OF

THE LEHIGH UNIVERSITY.

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Manual for the general Court. 2 Vols.
Census of Rhode Island, 1865.
Proceedings of the Trustees of the Peabody Educational Fund. Vol. 3.
Massachusetts Medical Society Digest.
Boston City Auditor's Report. 3 Vols.
And 74 Pamphlets.

From the Hon. Richard Vaux, Philadelphia.

Annual Report of the Inspectors of the State Penitentiary of the Eastern District of Pa.

From the Hon. Wm. Mutchler, Easton, Pa.

War of the Rebellion. Series 1. Vol. 19, Part 2. Vol. 20, Parts 1 and 2, and Vol. 21. 4 Vols.

From the Hon. J. D. Cameron, Harrisburg, Pa.

War of the Rebellion. Series 1. Vol. 19, Part 2. Vol. 20, Parts 1 and 2, and Vol. 21. 4 Vols.
U. S. Coast and Geodetic Survey. Appendix No. 12. 1886.

From Mrs. E. A. de Schweinitz, Bethlehem.

In Memoriam. Edmund Alexander de Schweinitz.

From L. Van Wyck, New York.

Twenty-Ninth Annual Report of the Trustees of the Cooper Union.

Fourth Report of the Commissioners of Electrical Subways of Brooklyn.

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Banquet to Commemorate the Framing and Signing of the Constitution of the United States.

From Rev. Samuel Fuller, Middletown, Conn.

Names of The Sacrament of Our Redemption.

From Hon. James P. Kimball, Washington, D. C.

A Bill to Amend the Law on Coins.
Report of the Director of the Mint. 1887.
Report of the Fish Commissioner, Part 13.
Precious Metals in the United States. 1886.
Department Reports. 5 Pamphlets.

From Gen. A. W. Greely, Chief Signal Officer, Washington, D. C.

Annual Report of the Chief Signal Officer, for 1887. Part 1.
Tri-Daily Meteorological Record. 4 Vols.
International Meteorological Bulletin. 6 Vols.

From Hon. W. H. Sowden, Allentown,

Congressional Record. Vol. 18. Parts 1. 2. 3. and Index. 4 Vols.
Growth of Industrial Art.

From Prof. G. H. Cooke, New Brunswick, N. J.

Annual Report of the State Geologist of New Jersey. 1887.
Three Sheet Atlases of New Jersey.
State Map of New Jersey.
Relief Map of New Jersey.

From Hon. P. S. Bachman, Freemansburg.

Report on Agriculture of Pennsylvania. 1887.
Report of Pennsylvania State College. 1886.
Auditor General's Report of 1887. 2 Vols.
Report of Inspector of Mines. 1886.
Reports of the Secretary of Internal Affairs, for 1886-1887. 2 Vols.
Smull's Legislative Hand Book. 1888.

From Joseph Jones. M. D., New Orleans, La.

Quarantine and Sanitary Operations.
Contagious and Infectious Diseases.
Medical and Surgical Memoirs. Vol. 1.

From John G. Ames, Washington, D. C.

Annual Report regarding the Receipt and Distribution of Public Documents on Behalf of the Government by the Department of the Interior.

From J. R. Leeson, Boston, Mass.

Flax. Shall it be "Free" or "Protected"?
Flax Culture in the United States.

From James Mahon, South Bethlehem.

Paper Book of Plaintiff in Error. Kuklence vs. Vocht.

From Edward A. Moseley, Washington, D. C.

First Annual Report of the Interstate Commerce Commission.

From Charles McKean Leoser, New York.

Annual Reports of the Chamber of Commerce of New York. 1884–1887. 3 Vols.

From E. and H. T. Anthony & Co., New York.

Anthony's Photographic Bulletin. 1887–1888.

From J. Ridgeway Wright, Wilkes-Barre.

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Agriculture of Pennsylvania. 2 Vols.
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Vosburg Tunnel.

From Prof E. H. S Bailey, Lawrence, Kansas.

Transactions of the Kansas Academy of Sciences. Vol. 10.
Sorghum Sugar Industry of Kansas.

From G. Follansbee, Pittsburgh.

Pittsburg's Progress, Industries and Resources.

From the Pratt and Whitney Co., Hartford, Conn.

Standards of Length and their Practical Application.

From J. H. Horton, Buffalo, N. Y.

Buffalo. Its History and Institutions.

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From Alfred R. C. Selwyn, Ottawa, Canada.

Annual Report of Geological Survey of Canada. Vol. 2. 1886 and Maps.

From Hon Daniel Ermentrout, Reading.

U. S. Coast and Geodetic Survey. Appendix No. 12. 1886.

From Mrs. Elizabeth Thompson, Stamford, Conn.

The High Caste Hindu Woman. By Ramabai.

From J. M. Forster, Harrisburg.

Insurance Report for 1887.

From Bonfort and Leoser, New York.

Bonfort's Wine and Spirit Circular. Vols. 38 and 39.

From R. W. Shufeldt, Washington, D. C.

Observations, U. S. Naval Observatory, 1883.

From the Institution of Civil Engineers, London, Eng.

Minutes of Proceedings. Vols. 91. 92. 93.

From the American Society of Civil Engineers.

Transactions of the Society for 1888.

From the American Society of Mining Engineers.

Transactions. Vol. 16.
Index to Transactions.

From the American Iron and Steel Association.

Annual Statistical Report.
Directory to the Iron and Steel Works of the U. S.

From the Alumni Association of Lehigh University.

Proceedings June 1886 to June 1887.
The Labor Problem of To-day, by F. A. Walker.

From the Agricultural College Library, Ingham Co., Mich.

Twenty-Sixth Annual Report of the Michigan Board of Agriculture.

From the Brooklyn Library.

Twenty-Eighth and Twenty-Ninth Annual Reports of Directors.
Bulletin of New Books. 11 Pamphlets.

From the Boston Public Library.

Bulletin. Vol. 4. No. 11. Vol. 5. Nos. 3. 4. and 7. Vol. 6. Nos. 1. 2. Vol. 7. No. 4. Vol. 8. Nos. 1. 2.

From the Harvard College Library.

Bibliographical Contributions. Nos. 17. 19. 22. 25. 26. 27. 28. 29. 30. 31.
Harvard University Bulletin. Nos. 39. 40.

From the Providence Public Library, R. I.

Tenth Annual Report.

From the Public Library, New Bedford, Mass.

Catalogue of Fiction.

From the State Library, Harrisburg.

State Reports, Pa. 11 Vols.

From the Peabody Institute, Baltimore, Md.

Twentieth Annual Report.

From the Peabody Museum, Cambridge, Mass.

Twenty-first Annual Report.

From the Smithsonian Institution, Washington, D. C.

Smithsonian Report, 1885, Part 2.
Smithsonian Miscellaneous Collections, Vols. 31. 32. 33.

From the Pennsylvania R. R. Co.

Forty-first Annual Report.

From Poor's R. R. Manual Co., New York.

Poor's Manual of Railroads for 1885.

From the Imperial University of Japan.

Memoirs.

From Argentine Republic.

Census Reports, 2 Pamphlets.

From U. S. Navy Department.

Nautical Almanac. 1891.

From U. S. Treasury Department.

Report of Director of the Mint, 1883.

From the Commissioner of Agriculture, Washington. D. C.

Report for 1887.

From Insurance Department of Pa.

Fifteenth Report of Life Insurance.

From the Commissioners of Second Geol. Survey of Penna.

Annual Report for 1886, Parts 1. 2. 3; and Atlas to part 2.
Atlas of Bucks and Montgomery Counties.
Atlas of Western Middle Anthracite Field. Part 2.

From U. S. Department of State.

Consular Reports, Nos. 83 to 92 inclusive.
Index to Consular Reports.
Technical Education in Europe. Part 1. By Schoenhof.

From U. S. War Department.

Annual Report of the Chief of Engineers of the U. S. Army, 1886–7- 7 Vols.
Report of Chief Signal Officer, 1886.
Official Army Register, Jan. 1888.
Annual Report of Board of Visitors of U. S. Military Academy.

From U. S. Treasury Department.

U. S. Coast and Geodetic Survey. Report for 1886.

From U. S. Department of the Interior.

Annual Report of Commissioner of Patents, 1887.
Forty-Eight Vols. of Public Documents and 1 Pamphlet.

From U. S. Geological Survey.

Forty-Two U. S. Atlas Sheets.

From the U. S. Bureau of Education.

Circulars of Information Nos. 1 and 2 for 1887.
Report of Commissioner of Education 1885–1886.
Study of History in American Colleges and Universities, By H. B. Adams.
The Republic of Mexico in 1876.
Report of the Mexican Border Commission.

From U. S Civil Service Commission.

First Annual Report.

From the Authors.

Poetry. An Address. By Daniel Agnew.
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Varieties in Verse. By R. A. Macfie.
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Brüder Botschafter.
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South Bethlehem Daily Star.
Evening Telegraph.
Catasauqua Dispatch.
Mauch Chunk Democrat.

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Six Templates of Rail Sections.

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From the Geological Survey of New Jersey.

Three Topographical Maps.

From the Chief of Ordnance, U. S. A.

Annual Report for the year 1887.

DONATIONS TO DEPARTMENT OF MECHANICAL ENGINEERING.

From Buckeye Engine Co., Salem, Ohio.

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Also thirty-two copies of Buckeye Engine Catalogs, Parts 1 and 2, for distribution to Senior class in M.E.

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Bound catalogue of machinery.

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Also framed photograph of Ball Engine.

From Strong Locomotive Co., New York, N. Y.

Fifty copies of Journal of the Franklin Institute containing description of the Strong Locomotive.

Also fifteen plates 12″ x 19″ of Strong Locomotive details accompanied by report of E. D. Leavitt, Jr.

From Betts Machine Co., Wilmington, Del.

Ten Framed photographs $14\frac{1}{2}$″ x $17\frac{1}{2}$″ of heavy machine tools.

From Fitchburg Steam Engine Co., Fitchburg, Mass.

Blue prints of two styles of horizontal stationary engines and of shaft governor.

From Chas. A. Shieren & Co., New York, N. Y.

Sample of leather link belt.

From Wainwright Manufacturing Co., Boston, Mass.

Sample of corrugated brass tubes.

From Deane Steam Pump Co., Holyoke, Mass.

Framed engraving of new high duty compound condensing pumping engine.

From R. H. Wood & Co., Philadelphia, Pa.

Framed photograph of 3 lift gas holder of 1,600,000 cubic feet capacity.

Also bound catalogue of structural iron work-pipes, etc.

From J. P. Morris, Philadelphia, Pa.

Framed photograph of large boiler for Calumet & Hecla Mining Co.

From Brown & Sharp Manufacturing Co., Providence, R. I.

Two Engravings of their works.

From Ford & Kendig Co., Philadelphia, Pa.

Handsome bound catalogue of pipes, fittings, radiators, tools, etc.

From James Brandon, New York City.

One 5-inch Piston with Patent Packing.

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Samples of Lead Ore.

From Prof. C. F. Chandler, New York.

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From H. S. Miner.

Tubes for Maple Sugar Tapping.

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OF

THE LEHIGH UNIVERSITY,

SOUTH BETHLEHEM, PA.,

1889-1890.

FOUNDED BY ASA PACKER.

TUITION FREE.

BETHLEHEM, PA.,
THE COMENIUS PRESS.
1890.

TABULAR ALMANAC.

1889.

JULY.

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1889-1890.

1889. Sept. 7, 9, 10,	Saturday, Monday and Tuesday,	Examinations for Admission.
Sept. 11,	Wednesday,	First Term begins.
Oct. 10,	Thursday,	Founder's Day.
Nov. 28,	Thursday,	Thanksgiving Day.
Dec. 18,	Wednesday,	First Term ends.
1890. Jan. 7, 8,	Tuesday and Wednesday,	Examinations for Admission to Second Term.
Jan. 8,	Wednesday,	Second Term begins.
Jan. 18,	Saturday,	Junior Prize Orations due.
Feb. 22,	Saturday,	Washington's Birthday.
Feb. 19,	Wednesday,	Ash Wednesday.
April 3,	Thursday,	Easter Holidays begin.
April 8,	Tuesday,	Easter Holidays end at 8¼ A.M.
May 26,	Monday,	University-Day Orations due.
May 28,	Wednesday,	Theses of Seniors due.
May 28,	Wednesday,	Senior Examinations begin
June 4,	Wednesday,	Annual Examinations begin.
June 7,	Saturday,	Senior Examinations end.
June 11, 12, 13,	Wednesday, Thursday and Friday,	Examinations for Admission.
June 15,	Sunday,	Baccalaureate Sermon.
June 17,	Tuesday,	Class Day.
June 18,	Wednesday,	Alumni Day.
June 19,	Thursday,	University Day.

1890-1891.

1890. Sept. 6, 8, 9,	Saturday, Monday and Tuesday,	Examinations for Admission.
Sept. 10,	Wednesday,	First Term begins.
Oct. 9,	Thursday,	Founder's Day.
Nov. 27,	Thursday,	Thanksgiving Day.
Dec. 17,	Wednesday,	First Term ends.
1891. Jan. 6, 7,	Tuesday and Wednesday,	Examinations for Admission to Second Term.
Jan. 7,	Wednesday,	Second Term begins.
June 18,	Thursday,	University Day.

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HARVEY S. HOUSKEEPER, B.A.,
Instructor in Physics.

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Instructor in Mathematics.

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Instructor in Civil Engineering.

PAUL J. DASHIELL, B.A.,
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ERNEST A. CONGDON, PH.B.,
Instructor in Qualitative Analysis and Assaying.

GEORGE W. SHERWOOD, B.A., C.E.,
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RALPH M. WILCOX, PH.B.,
Instructor in Drawing.

RICHARD O. HEINRICH,
Instructor in Physics.

HARRY H. STOEK, B.S., E.M.,
Instructor in Mining and Geology.

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Sci.—Course in Science and Letters.
A.C.—Analytical Chemistry.
Arch.—Architecture.
C.E.—Civil Engineering.
E.M.—Mining Engineering.
M.E.—Mechanical Engineering.
Met.—Metallurgy.
E.E.—Electrical Engineering.

The students whose names are printed in *italics* are not clear of conditions.

GRADUATES.

	For Degree.	Residence.
James W. Anderson, B.S.,	E.M.,	Washington, D. C.
Samuel Erwin Berger, B.A.,	M.A.,	Richland Centre.
Albert Gallatin Brodhead, B.A., (Harvard University.)	C.E.,	Wilkes-Barre.
William Henry Dean, A.C.,	E.M., M.S.,	Wilkes-Barre.
Charles Estell Dickerson, jr., B.S.,	M.S.,	Mt. Hermon, Mass.
George Francis Duck, E.M.,	Ph.D.,	Rapid City, Dak.
Harvey Sheafe Fisher, B.A.,	M.A.,	Pottsville.
Samuel Wilson Frescoln, C.E.,	M.S.,	Reading.
Frederick Louis Grammer, B.S.,	E.M.,	Baltimore, Md.
Conrad Egbert Hesse, B.S.,	E.M.,	Washington, D. C.
Robert Browne Honeyman, B.S.,	E.M.,	Bethlehem.
Preston Albert Lambert, B.A.,	M.A.,	South Bethlehem.
Sylvanus Elmer Lambert, B.A.,	M.A.,	Philadelphia.
Lionel R. Lenox, Ph.B., (Columbia University.)	M.S.,	South Bethlehem.

	For Degree.	Residence.
Wilson Franklin More, B.A.,	M.A.,	Catasauqua.
George Spencer Patterson, E.M.,	M.S.,	Mahanoy City.
Albert George Rau, B.S.,	M.S.,	Bethlehem.
Arnold Karthaus Reese, B.S.,	E.M.,	Baltimore, Md.
Joseph William Richards, A.C.,	M.S.,	Bethlehem.
Edward Orth Robinson, B.A., (College of New Jersey.)	E.E.,	Allegheny City.
Lewis Buckley Semple, B.A.,	M.A.,	Bethlehem.
Martin D. Sibert, B.C.E., B.M.E., (University of Alabama.)	C.E.,	Gadsden, Alabama.
Arthur Moult Smyth, B.S.,	E.M.,	Philadelphia.
Joseph Kiddoo Surls, B.M.,	M.S.,	Anniston, Ala.
William Patterson Taylor, B.A.,	M.A.,	Philadelphia.
Augustus Thompson Throop, C.E.,	M.S.,	Port Gibson, N.Y.
Clarence Walker, B.S.,	E.M.,	Pottsville.
Samuel Dexter Warriner, B.A., (Amherst College.)	E.M.,	Montrose.
John R. Wagner, M.E.,	E.M.,	Drifton.

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Frederick Richard Barrett,	C.E.,	Fort Marcy, N. M.
Edwin Herbert Beazell,	C.E.,	Chillicothe, Mo.
James W. Boyd,	C.E.,	Seek.
Adolph Cardenas,	C.E.,	Nicaragua.
William Phelps Cleveland,	A.C.,	Waterville, N. Y.
Frank Raymond Coates,	E.M.,	Philadelphia.

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Charles Ellery Coxe,	E.M.,	Reading.
James Barlow Cullum,	A.C.,	Meadville.
John Rose Davis,	C.E.,	Phœnixville.
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Clement Heyser Detwiler,	C.E.,	Ironbridge.
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Frank Roberts Fisher,	C.E.,	Philadelphia.
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Harry Walter Harley,	M.E.,	Gloucester, N. J.
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*James S. B. Hollinshead,	E.M.,	Dayton, O.
Frederic Kidder Houston,	M.E.,	New York City.
William Vincent Kulp,	C.E.,	Norristown.
Henry Meyers Kurtz,	C.E.,	Shamokin.
Harry Kinzer Landis,	E.M.,	Landis Valley.
John Elmer Litch,	M.E.,	Steelton.
Thomas Smith Leoser,	A.C.,	New York City.
Robert Sayre Mercur,	E.M.,	Wilkes-Barre.
Charles Herbert Miller,	A.C.,	Huntingdon.
George Nauman, jr.,	C.E.,	Lancaster.
Robert Engler Neumeyer,	C.E.,	Bethlehem.
William Cassidy Perkins,	C.E.,	Williamsport.
Asa Emory Phillips,	C.E.,	Washington, D.C.
Alexander Potter,	C.E.,	Halifax, N. S.

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Edwin Jay Prindle,	M.E.,	Washington, D.C.
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John Stover Riegel,	M.E.,	Riegelsville, N. J.
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William Alston Stevenson,	M.E.,	Lewistown.
Theodore Alfred Straub,	C.E.,	Allegheny.
Francis Dupont Thomson,	M.E.,	Philadelphia.
Charles Cookman Tomkinson,	M.E.,	Harrisburg.
Claude Allen Porter Turner,	C.E.,	Lime Rock, R. I.
Aaron Howell Van Cleve,	C.E.,	Easton.
David Thomas Williams,	M.E.,	Catasauqua.
Herbert Wright,	M.E.,	Northampton, Mass.

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Juan de la Rosa Barrios,	E.M.,	Bogota, U. S. Colombia.
John Mayall Beaumont,	M.E.,	Scranton.
Harry Weed Biggs,	C.E.,	Glendale, O.
James Edwin Boatrite,	C.E.,	Columbus, Ga.
Herman Stadiger Borhek,	E.E.,	Bethlehem.
William Young Brady,	Arch.,	Franklin.
George Briggs,	E.E.,	Scranton.
Jacob Burr Buckley,	E.E.,	Oxford, N. Y.
Emanuel Chao,	C.E.,	Cienfuegos, Cuba.

	Course.	Residence.
Charles Houghton Corbin,	A.C.,	Telluride, Col.
Edward Haviland Coxe,	C.E.,	Reading.
Warder Cresson,	M.E.,	Swarthmore.
Eric Doolittle,	C.E.,	Bethlehem.
Alban Eavenson,	A.C.,	Philadelphia.
Harry S. Eckert,	A.C.,	Reading.
Lester Hallett Ely,	A.C.,	New York City.
Juan de la Cruz Escobar,	M.E.,	Matanzas, Cuba.
Walter Lowe Fairchild,	E.E.,	Elmira, N. Y.
Walton Forstall,	E.E.,	Chicago, Ill.
Eugene Uz Gibbs,	M.E.,	Mt. Holly, N. J.
John Stilwell Griggs,	M.E.,	New Haven, Conn.
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John Sidney Heilig,	M.E.,	Catasauqua.
William Albert Heindle,	C.E.,	Baltimore, Md.
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Amos Dey Kennedy, jr.,	E.E.,	Philadelphia.
Hermann Meriwether Knapp,	C.E.,	Louisville, Ky.
Harry Kramph,	C.E.,	North Platte, Neb.
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Henry Lefevre,	E.M.,	Panama, U.S.Colombia.
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Joseph Simonson Lockwood,	E.E.,	Brooklyn, N. Y.
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George Hillard Lynch,	C.E.,	Wilkes-Barre.
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William David Matheson,	A.C.,	Brooklyn, N. Y.
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Edgar Randolph Reets,	A.C.,	Wilkes-Barre.
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Robert Schmitz,	C.E.,	Egg Harbor City, N. J.
Anton Schneider,	C.E.,	Summit Hill.
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Noble Banks,	E.M.,	Savannah, Ga.
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Charles Merritt Case,	E.M.,	Minneapolis, Minn.
George Price Case,	E.M.,	Minneapolis, Minn.
Henry Clark, jr.,	E.M.,	Montgomery City, Mo.
Philip Lothrop Cobb,	C.E.,	Cleveland, Ohio.
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Morgan Davis,	E.M.,	Mt. Carmel.
Heber Denman,	E.M.,	Kendall Creek.
Edwin Dodge,	E.M.,	Gouverneur, N. Y.
Daniel Edward Downey,	M.E.,	South Bethlehem.
Robert Arthur Downey,	C.E.,	Oswego, N. Y.
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Howard Weidener DuBois,	E.M.,	Philadelphia.
George Washington Engle,	E.M.,	Ashland.

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Robert Blum Olney,	C.E.,	Charleston, S. C.
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Ramon Eckhart Ozias,	E.E.,	Quakertown.

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James Pius Rafferty,	M.E.,	Chicago, Ill.
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Samuel Arthur Rhoads,	E.E.,	Birdsboro.
John Ira Riegel,	C.E.,	South Bethlehem.
Edwin Gray Rust,	M.E.,	Leesburg, Va.
John Bonner Semple,	A.C.,	Pittsburgh.
Edward Hagan Shaw,	M.E.,	Philadelphia.
Cass Knight Shelby,	M.E.,	Grand Rapids, Mich.
James Causten Shriver,	E.M.,	Cumberland, Md.
Charles Henry Simpson,	C.E.,	Pensacola, Fla.
Oscar Emmerson Smith,	C.E.,	Portsmouth, Va.
Philip Henry Smith,	E.E.,	Parsippany, N. J.
Robert Jones Snyder,	M.E.,	Bethlehem.
John Stewart,	E.M.,	Lonaconing, Md.
Thomas Cedwyn Thomas,	C.E.,	Wilkes-Barre.
Lester Warren Walker,	E.E.,	North Platte, Neb.
David Hykes Witmer,	C.E.,	Annville.
Frederic Wittman,	A.C.,	Lanark.
Charles Oaks Wood,	M.E.,	Chambersburg.
Byron Edgar Woodcock,	E.M.,	Altoona.

FRESHMAN CLASS.

	Course.	Residence.
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Harry Doughten Appleby,	C.E.,	Wilmington, Del.
Miltiades Themistocles Armas,	C.E.,	Trebizond, Asia Minor.
Harry Jacob Atticks,	E.E.,	Lisburn.
George Thomas Bache,	E.M.,	Nanticoke.
David Balliet,	C.E.,	Normal Square.
Joseph Clinton Ballou,	A.C.,	Becket, Mass.
Charles Bartles, jr.,	E.M.,	Williamsport.
Clarence Earle Belfield,	E.E.,	Philadelphia.
Carville Dickinson Benson,	C.E.,	Arbutus, Md.
Edward Keating Bishop,	E.E.,	Chicago, Ill.
William Irvin Boyd,	C.E.,	Washington, D. C.
Samuel Branson,	M.E.,	Wrightstown, N. J.
Fred. Edgar Bray,	C.E.,	Industry.
Alfred Tennyson Brown,	E.E.,	Rising Sun, Ind.
Rezeau Blanchard Brown,	M.E.,	Somerville, N. J.
George Stuart Wylie Brubaker,	E.E.,	Lancaster.
Gilbert Forbes Burnett,	Sci.,	New Providence, N. J.
Ellis Buchanan Byllesby,	L.S.,	Allegheny.
Langston Byllesby,	Sci.,	Allegheny.
John Salmon Carman,	A.C.,	Washington, D.C.
Frederick Cowan Carnaghan,	E.M.,	New York City.
George Edwin Chamberlain,	A.C.,	Pittston.
Morris Llewellyn Cooke,	M.E.,	South Bethlehem.
Warren Fellman Cressman,	C.E.,	Sellersville.
John Purviance Culbertson, jr.,	E.E.,	Chambersburg.

	COURSE.	RESIDENCE.
George Milton Curtis, jr.,	L.S.,	New York City.
Samuel Philip Curtis,	C.E.,	Penn Yan, N. Y.
William Russel Davis,	C.E.,	Walpole, N. H.
Walter Joseph Dech,	Clas.,	Bethlehem.
Jacob De Haan,	E.E.,	Netherlands.
Alden Brown Diven,	C.E.,	Elmira, N. Y.
Charles Malcolm Douglass,	Clas.,	Belvidere, N. J.
Charles Hazard Durfee,	E.E.,	Fall River, Mass.
Harry Clifford Eddy,	E.E.,	Morristown, N. J.
James Marshall Edgar,	E.E.,	Chambersburg.
John Jay Edson, jr.,	C.E.,	Washington, D. C.
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Edward Fargason,	M.E.,	Memphis, Tenn.
Frederic Percival Farrar,	A.C.,	London, England.
Robert Ferriday,	C.E.,	South Bethlehem.
Henry Cowan Blair Finley,	E.M.,	Chattanooga, Tenn.
Richard Daniel Floyd,	Sci.,	Milton, Mass.
George Harwood Frost,	M.E.,	Plainfield, N. J.
Frederick Pardee Fuller,	E.E.,	Scranton.
Robert Foster Gadd,	C.E.,	Sudlersville, Md.
Charles Willits Gearhart,	E.E.,	Danville.
Albert Ross Gee,	E.E.,	Fall River, Mass.
Gustavus Adolphus Gessner, jr.,	E.M.,	Fremont, O.
Lyle Nugent Gillis,	C.E.,	Alexandria, Va.
Harvey Hartzell Godshall,	A.C.,	Landsdale.
Samuel Laury Graham, jr.,	E.M.,	Pinewood, Tenn.
John Grant,	A.C.,	Margaretville, N. Y.
Samuel Wilbur Grubb,	C.E.,	Philadelphia.
Albert Arthur Guilbert,	E.E.,	Racine, Wis.

	Course.	Residence.
Peter Wilson Hairston,	E.E.,	Walnut Cove, N. C.
George Hervey Hallett,	Clas.,	Pottsville.
John Nicholas Halter,	C.E.,	Los Angeles, Cal.
Lee Stout Harris,	C.E.,	Silver Brook.
Claude Sanford Haynes,	C.E.,	Elmira, N. Y.
Robert Culbertson Hays Heck,	M.E.,	Heckton Mills.
Howard Bright Heller,	M.E.,	South Bethlehem.
Bayly Hipkins,	M.E.,	Oakland, Md.
William Geer Hitchcock,	E.E.,	New York City.
George Perry Hodgman,	M.E.,	Wilmington, Del.
William Emley Holcombe,	E.E.,	Lambertville, N. J.
Hartley Howard, jr.,	E.E.,	Pittsburgh.
Rollin Germaine Hubby,	E.E.,	Cleveland, O.
Lester Mead Hubby,	L.S.,	Cleveland, O.
Edward Blackstone Hurst,	C.E.,	Cincinnati, O.
George Cass Hutchinson,	M.E.,	Sewickley.
Turie Seibert Ickes,	C.E.,	Newport.
Charlie Borrows Jacobs,	E.M.,	Slatington.
Fred. Kittredge Jenney,	L.S.,	Kansas City, Mo.
Guillemo Enrique Jimeno,	C.E.,	New York City.
William Stricklar Jones,	E.M.,	Greensburg.
Sylvester Dwight Judd,	E.M.,	West Orange, N. J.
Charles Lincoln Keller,	M.E.,	Dubuque, Iowa.
Henry Whitman Kern,	M.E.,	Chicago, Ill.
Herman Eugene Kiefer,	A.C.,	Altoona.
Schuyler Brush Knox,	C.E.,	Carthage Landing, N. Y.
Louis John Krom,	A.C.,	Plainfield, N. J.
Harry Donaldson Leopold,	C.E.,	Tamaqua.
Frank Sigismund Loeb,	A.C.,	Columbia.
John Douglas Lowry,	E.E.,	Washington, D. C.
Clarence Oliver Luckenbach,	M.E.,	Bethlehem.

	Course.	Residence.
William Price Marr,	E.E.,	Shamokin.
John Vansickle Martenis,	E.E.,	South Bethlehem.
Frederick Chandler Mathewson,	E.M.,	Pomfret, Conn.
Joseph Oscar Mathewson, jr.,	E.M.,	Augusta, Ga.
George Holbrooke Maurice,	C.E.,	Athens.
James Edgar Miller,	C.E.,	Chicago, Ill.
Walter Chambers Miller,	E.M.,	Sewickley.
Rudolph Clarence Möllmann,	E. E.,	Germantown.
William Frederick Mylander,	C.E.,	Baltimore, Md.
Hiram Dryer McCaskey,	E.M.,	Fort Assineboine, Mont.
Francis Marion McCullough,	E.E.,	Altoona.
John Douglas McPherson, jr.,	E.E.,	Washington, D. C.
Harvey Frankenfield Nase,	C.E.,	Springtown.
Alphonso Robert Nicholson,	A.C.,	Jenkintown.
Clinton Ledyard Olmsted,	C.E.,	Eagle Village, N. Y.
Charles Joseph O'Neill,	E.E.,	Washington, D. C.
Miguel Orozco, jr.,	C.E.,	Colombia, S. A.
Charles William Parkhurst,	E.E.,	Hammonton, N. J.
Duncan White Patterson,	M.E.,	Safe Harbor.
John Gates Peck,	C.E.,	Stow, Mass.
Wilbur Orton Polhemus,	C.E.,	Nyack, N. Y.
Stephen Collins Potts,	A.C.,	Altoona.
Mervin Paul Randolph,	E.E.,	Atglen.
Raymond Bernard Randolph,	A.C.,	Montclair, N. J.
Charles Allen Rea,	E.E.,	Mill Green, Md.
Joel Howard Reber,	E.E.,	Allentown.
John Graham Reid,	C.E.,	Danville.
Harold Kinney Rice,	M.E.,	Addison, N. Y.
James Clement Richardson, jr.,	E.E.,	Glendale, O.
Lewis Daniel Rights,	C.E.,	Tahlequah, Ind. Ty.
George William Ritchey,	L. S.,	Pittsburgh.

	Course.	Residence.
Samuel Neely Riter,	M.E.,	Stoops Ferry.
William Locke Rockwell,	A.C.,	Plainfield, N. J.
Charles Beecher Rutter,	E.M.,	Lansford.
Clement Clarence Rutter,	C.E.,	Lansford.
Frederic Brittan Sage,	E.E.,	Hackensack, N. J.
Martin Luther Saulsbury,	C.E.,	Ridgely, Md.
Edmund Munroe Sawtelle,	M.E.,	Washington, D. C.
Joseph A. Schloss,	A.C.,	Elmira, N. Y.
Armin Schotte,	C.E.,	New York City.
Frank Schutte,	A.C.,	Philadelphia.
Eugene Schwinghammer,	E.E.,	Egg Harbor City, N. J.
Thomas Elvin Semmel,	Sci.,	Kreidersville.
William Frederick Semper,	A.C.,	Philadelphia.
Christian Thomsen Shannon,	E.E.,	Pittsburgh.
Alexander Beatty Sharpe,	E.M.,	Steubenville, O.
Adelbert Sheldon,	C.E.,	Royalton, N. Y.
Oswin Weinberger Shelly,	Arch.,	Milford Square.
Carroll Bradford Smith,	E.E.,	Norristown.
Clarence Galen Smith,	A.C.,	Cleveland, O.
Floyd Kipp Smith,	C.E.,	Bayonne, N. J.
Noel W. Smith,	C.E.,	Williamsport.
Richard Andrew Lee Snyder,	E.E.,	Carlisle.
Edward Augustus Soleliac,	M.E.,	Allentown.
Alfred Earnest Speirs,	Clas.,	Bethlehem.
Charles Paxton Stackhouse,	M.E.,	Shickshinny.
George Stern,	Clas.,	Frostburg, Md.
William Renick Stinemetz,	E.E.,	Washington, D. C.
David Reese Stockton,	E.E.,	Phœnixville.
Charles Andrew Straw,	E.M.,	Wilkes-Barre.
John Taylor, jr.,	A.C.,	Bethlehem.
Wilson Jones Taylor,	C.E.,	Edgmont.

	Course.	Residence.
Charles Wickliffe Throckmorton,	E.E.,	Rosebank, N. Y.
John Harry Tonkin,	C.E.,	Wilkes-Barre.
Lewis Esler Troutman,	E.E.,	Pottsville.
Orson William Trueworthy,	E.E.,	Washington, D. C.
John Moore Van Cleve,	E.E.,	Sewickley.
Jacob Von Maur,	C.E.,	West Pittston.
Fred. Conover Warman,	C.E.,	Washington, D. C.
Winfield Lemuel Warner,	M.E.,	Brooklyn, N. Y.
William J. Weatherby,	M.E.,	Swedesboro, N. J.
James Maxwell Welch,	M.E.	Uhrichsville, O.
Walter Wynne Wentworth,	E.E.,	Slatington.
Charles Drake Westcott,	E.E.,	Washington, D. C.
James Horatio Westcott, jr.,	Sci.,	Wilmington, Del.
Henry Blackstone Wilkins,	A.C.,	Baltimore, Md.
John Lewis Williams,	E.M.,	Wilkes-Barre.

SPECIAL STUDENTS.

	Course.	Residence.
William Alexander Auchinvole,	A.C.,	Harrisburg.
Hanson Entriker Atkins,	M.E.,	Pottsville.
Allen Harwood Babcock,	A.C.,	Oakland, Cal.
William Williams Blunt,	E.E.,	Goshen, Md.
Ezekiel McNeal Bond,	E.E.,	Bolivar, Tenn.
Frederick Stanley Camp,	E.E.,	Brooklyn, N. Y.
Charles Joseph Coll,	C.E.,	Broad Ford.
Harold Beecher Conant,	E.M.,	New York City.
George Edmund Gay,	E.M.,	Pottsville.
Cornelius Silsby Hawkins,	E.E.,	Fall River, Mass.
Augustus Francis Horne,	A.C.,	Allentown.

	Course.	Residence.
Christopher Gadsen Howe,	C.E.,	Charleston, S.C.
Hagime Ichikawa,	A.C.,	Tokio, Japan.
Albert Edward Juhler,	A.C.,	Pomeroy, Ohio.
John LeDroit Langdon,	E.E.,	Buffalo, N. Y.
Charles Douglass Mather,	M.E.,	Kincardine, Ont., Can.
Charles Wiltberger Platt,	A.C.,	New York City.
Thomas Clement Rafferty,	E.E.,	Chicago, Ill.
Alexander Wand,	E.M.,	Danville.
Robert Jacob Yost,	A.C.,	South Bethlehem.
Roger Hanson Zimmerman,	E.M.,	Louisville, Ky.

SUMMARY OF STUDENTS BY CLASSES AND COURSES.

	Graduates.	*Seniors.*	*Juniors.*	*Sophomores.*	*Freshmen.*	*Specials.*	*Totals.*
Classical,	7	1	2	4	5	—	19
Latin-Scientific,	2	—	1	—	5	—	8
Science and Letters,	—	1	—	—	5	—	6
Civil Engineering,	4	29	22	22	44	2	123
Mechanical Eng.,	—	12	9	19	24	2	66
Mining Eng.,	14	5	9	19	17	4	68
Electrical Eng.,	1	—	13	11	44	6	75
Analytical Chem.,	1	6	11	4	20	7	49
Architecture,	—	—	2	1	1	—	4
Totals,	29	54	69	80	165	21	418

SUMMARY OF STUDENTS BY STATES.

New Hampshire,	1
Vermont,	1
Massachusetts,	9
Connecticut,	3
Rhode Island,	1
New York,	41
Pennsylvania,	211
New Jersey,	27
Delaware,	3
Maryland,	15
District of Columbia,	22
Virginia,	5
West Virginia,	2
North Carolina,	3
South Carolina,	3
Georgia,	6
Alabama,	2
Florida,	1
Louisiana,	1
Ohio,	15
Indiana,	1
Illinois,	6
Wisconsin,	2
Minnesota,	2
Michigan,	1
Iowa,	1
Missouri,	3

Kentucky,	2
Tennessee,	5
Kansas,	1
Louisiana,	1
Nebraska,	2
Dakota,	1
Colorado,	1
Montana,	1
California,	2
New Mexico,	1
Indian Territory,	1
Canada,	3
Cuba,	2
United States of Columbia,	3
Porto Rico,	1
England,	1
Netherlands,	1
Asia Minor,	1
Japan,	1
Total,	418

THE LEHIGH UNIVERSITY.

ORIGIN.

The Hon. Asa Packer, of Mauch Chunk, during the year 1865, appropriated the sum of Five Hundred Thousand Dollars, to which he added one hundred and fifteen acres of land in South Bethlehem, to establish an educational Institution in the rich and beautiful Valley of the Lehigh. From this Foundation rose The Lehigh University, incorporated by the Legislature of Pennsylvania in 1866. In addition to these gifts, made during his life-time, Judge Packer by his last will secured to the University an endowment of $1,500,000, and to the University Library one of $500,000.

DESIGN.

The original object of Judge Packer was to afford the young men of the Lehigh Valley a complete education, technical, literary and scientific, for those professions represented in the development of the peculiar resources of the surrounding region. In furtherance of this purpose instruction is liberally provided in Civil, Mechanical, Mining and Electrical Engineering, Chemistry, Metallurgy, Architecture, and in all needful collateral studies. A School of General Literature is also established and thoroughly equipped, with three departments, called respectively the Classical, the Latin-Scientific, and that of Science and Letters. These departments are kept up to the standard, and the requirements for entrance are the same as those of our best Classical and Literary institutions.

FREE TUITION.

All these educational facilities are provided without charge. Through the generosity of the Founder, the Trustees were enabled, in 1871, to declare tuition FREE in all

branches and classes. The Lehigh University is open to young men of good character and suitable preparation from every part of our own land and of the world. To this fact the attention of the pupils of our public schools and of the graduates of classical institutions is especially called. Thus is offered, *without charge*, every facility for studying the professions of the Civil, Mechanical, Mining and Electrical Engineer, and of the Metallurgist, Analytical Chemist and Architect. In the Classical and Scientific departments of the School of General Literature instruction is given in the Classics, Sciences and Letters.

PUBLIC WORSHIP.

Prayers are held in the Packer Memorial Church of the University every morning and all students are required to be present.

Divine Service is held on every Sunday morning in the Church. The service is according to the forms of the Protestant Episcopal Church, under whose auspices the University was placed by its Founder. Attendance is required of every student, except in case of those connected with other religious bodies, to whom the President will grant permission at the beginning of each term (if requested by the parent or guardian, or by the student himself if he be 21 years of age) to attend during that term the place of worship of the body with which he is connected, where attendance on Sunday morning will be required.

SITE.

The situation of the Institution is healthful and beautiful. The region is famous for its railway and manufacturing enterprises; it possesses some of the richest iron and coal mines in our land, and thus gives the students rare facilities for confirming the teachings of the recitation room by the observation of the eye.

The University Buildings are about a half-mile from the depot, at the junction of the Lehigh Valley and North Pennsylvania Railroads. New York is ninety-two, and Philadelphia fifty-four miles distant.

BUILDINGS.

PACKER HALL,

named after the Founder, stands seven hundred feet back of Packer Avenue, at the base of the South Mountain. It is built of stone, and contains Lecture and Recitation Rooms, the Drawing Rooms and the Museum of Geology and Natural History.

THE CHEMICAL LABORATORY

is thoroughly fire-proof, is built of sandstone, and is 219 feet in length by 44 in width.

There are two principal stories and a basement. The upper floor is occupied by the quantitative and the qualitative chemical laboratories, the former accommodating 48 and the latter 84 students. These rooms are 20 feet in height, and are well lighted and ventilated. A laboratory for industrial chemistry and the supply room are also on this floor.

The first floor contains a large lecture room, a recitation room, a chemical museum and laboratories for organic, physiological, agricultural and sanitary Chemistry.

In the basement is the large laboratory for the furnace assay of ores and a well appointed laboratory for gas analysis, also rooms containing the apparatus for several processes in industrial chemistry, the engine and air-pump for vacuum filtration, a store room and the toilet.

A photographic laboratory is located in the third story of the central portion of the building.

THE METALLURGICAL LABORATORY

contains a lecture room, a blowpipe laboratory for class instruction in blowpipe analysis and in the practical determination of crystals and minerals, a museum for mineralogical and metallurgical collections, a mineralogical laboratory provided with a Fuess reflecting goniometer, a polariscope, a Groth's "universal apparat" and a Rosenbusch polarizing microscope, a dry laboratory provided with furnaces for solid fuel and for gas with natural draught and with blast,

and a wet laboratory for ordinary analytical work. It is arranged for the instruction of classes in the courses of mineralogy, metallurgy and blowpipe analysis of the regular curriculum, and to afford facilities to a limited number of advanced students for familiarizing themselves with the methods of measurement and research employed in mineralogy and metallurgy, and for conducting original investigations in these departments of science.

THE PHYSICAL LABORATORY

consists of three stories. A large lecture room, with a seating capacity of 150, occupies a portion of the second and third floors. It is well lighted and adapted to its purposes. On the remainder of these floors are two rooms, each 40 feet long, for Heat and Light laboratories, a dark room for photographic work, spectroscopic and apparatus rooms and the private laboratories of the Instructors.

The lower floor is devoted to the use of the students in Electricity. A large room nearly 40 feet square is used as the Electrical Laboratory. There are smaller rooms for photometric and spectroscopic work, also reading, balance, apparatus and engine rooms. On this floor a 12 horse-power high speed engine and a dynamo supply two systems of electric lights, one of 25 incandescent lamps, the other of four arc lights, for practical tests in the Electrical Laboratory and for experimental purposes in the lecture room above. In the cellar are battery, store rooms, etc.

The tower and two rooms in the east end of Christmas Hall have been given to the Department of Physics and will be equipped as a Meteorological Observatory.

THE SAYRE OBSERVATORY.

Near Brodhead Avenue is the Sayre Observatory, the gift of Robert H. Sayre, Esq., of South Bethlehem, containing an equatorial and a zenith telescope, transit instrument and astronomical clock.

THE UNIVERSITY LIBRARY.

To the east of Packer Hall is the University Library, erected by the Founder in memory of Mrs. Lucy Packer Linderman, his daughter.

THE GYMNASIUM

is a handsome and spacious structure, built and equipped with the utmost thoroughness. It is furnished with the best patterns of gymnastic apparatus, besides Dr. Sargent's system of Developing Appliances. It is provided with hot and cold water; tub, sponge and shower baths, and 389 clothes closets. Opportunities for recreation and amusement are provided in the bowling alleys. It is under the immediate care of a skilled and competent Director.

All students are required to undergo a physical examination before being allowed the use of the Gymnasium, and this examination will be repeated once each year during their stay at the University. The proper exercise is prescribed and is required of every student. The aim of the institution is to promote a harmonious, symmetrical development best suited to the individual condition of the student.

EXPENSES.

Tuition is FREE in all branches and classes. Books, materials, paper, pencils, chemical materials used in the analytical laboratories and drawing instruments are furnished by the student. Materials consumed in the analytical laboratories are furnished to the student by the University at cost prices, their value being covered by a deposit made at the opening of that term in which the laboratory work is to be done.

Rooms and Board can not be had in University buildings, but can readily be obtained in many private houses.

The following is an estimate of the necessary expenses for the collegiate year, clothing and traveling not included:

Board for 40 weeks, . . .	from $160 to $200
Room-rent, with fuel and lights .	40 " 80
Care of room and use of furniture,	5 " 20
Washing and incidentals, . . .	20 " 40
Books, stationery, etc., . . .	25 " 50
Total, ...	$250 to $390

NOTE.—If clubs be formed the cost of board need not exceed $3.50 per week.

ADMISSION OF STUDENTS.

The Register is intended to give all necessary information concerning the admission of students. Application may be made to the President of the University if information is desired which is not given in the Register.

DATE OF EXAMINATIONS.

Examinations for admission to the University are held at the opening of each term, and also in June at the close of the Academic year.

The examinations for 1890 will be on Tuesday and Wednesday, January 7 and 8, for admission to the *second term;* on Wednesday, Thursday and Friday, June 11, 12 and 13, and on Saturday, Monday and Tuesday, September 6, 8 and 9, for admission to the first term. No other examinations for entrance will be held, except for good cause, and all applicants *must* be in attendance at 9 o'clock on the morning of the first day.

The examinations are held in the following order:

First Day.—English Grammar, 9 A.M.; Geography, 11.30 A.M.; United States History, 2 P.M.; Physical Geography, 4 P.M.

Second Day.—Geometry, 9 A.M.; Arithmetic, 2 P.M.; Algebra, 3.30 P.M.

Third Day.—Latin and Roman History, 9 A. M.; Elementary Physics, 9 A.M.; Greek and Greek History, 2 P.M.

CHARACTER OF THE EXAMINATIONS.

The examinations are rigorous and cover the entire ground laid down in the following scheme. They are all conducted in writing, supplemented by an oral examination at the option of the examiner.

Each candidate for admission must be at least sixteen years of age and must present a testimonial of good moral

character from his last Instructor, or from the School or Institute to which he last belonged, or from some reputable citizen of the community in which he lives.

Candidates for admission to

THE CLASSICAL COURSE

will be examined in the following subjects :

1. *English Grammar*, including composition, spelling and punctuation.

2. *Geography*, general and political.

3. *History of the United States*, including the *Constitution*.

4. *Arithmetic*, including the metric system of weights and measures.

5. *Algebra*, Fundamental Principles. Factoring. Least Common Multiple. Greatest Common Divisor. Fractions. Involution. Evolution. Radicals. Imaginary Quantities. Equations of the First and Second Degrees. Ratio. Proportion and Progressions.

[Olney's University Algebra is recommended, as it is the text-book used in the University.]

6. *Geometry*, Fundamental Principles. Rectilinear Figures. The Circle. Proportional Lines and Similar Figures. Comparison and Measurement of the Surfaces of Rectilinear Figures.

[Chauvenet's Geometry, (four books) is recommended, as it is the text-book used in the University.]

7. *Physical Geography.*

8. *Latin Grammar.*

9. *Cæsar*, four books of the Gallic war.

10. *Cicero*, six orations, including the four against Catiline.

11. *Vergil*, the first six books of the Aeneid, including Prosody.

12. The translation, at sight, of passages from Cæsar and Cicero.

13. The translation of English into Latin. (As special importance is given this part of the examination, it is suggested to teachers that they connect exercises in making

Latin, both oral and written, with all the studies of the preparatory course.)

14. *Roman History.* Creighton's Primer of Roman History is suggested as indicating the amount required.

15. *Greek Grammar.*

16. *Xenophon*, Anabasis, four books.

17. *Homer*, Iliad, first three books, including Prosody. The Catalogue of Ships may be omitted.

18. The translation, at sight, of a passage from some work of Xenophon.

19. *Greek History.* Fyffe's Primer of Greek History is suggested.

20. Writing Greek with accents.

The pronunciation of Greek according to the written accents is followed in the University, and it is desirable that students preparing to enter be taught this system.

Latin is pronounced according to the so-called Roman Method.

THE LATIN-SCIENTIFIC COURSE.

Candidates for admission to this course must present the first fourteen of the above requirements, but will substitute for the Greek sections (numbers 15–20 inclusive) the following:

21. *Geometry*, Regular Polygons. Measurement of the Circle. Maxima and Minima of Plane Figures, and Plane and Polyhedral Angles; these constituting the subject matter of Books Five and Six of Chauvenet's Geometry.

THE COURSE IN SCIENCE AND LETTERS.

Candidates for admission to this course are examined in all the subjects demanded of those entering the Latin-Scientific Course, except the Latin and Physical Geography sections (numbers 7 to 14 inclusive). They will also present the following:

22. *Elementary Physics.*

[Avery's Elements of Natural Philosophy (revised edition) is recommended.]

THE SCHOOL OF TECHNOLOGY.

Candidates for admission to the Courses in Civil Engineering, Mechanical Engineering, Mining and Metallurgy, Electrical Engineering, Chemistry and Architecture will be examined in the following subjects:

1. *English Grammar*, including composition, spelling and punctuation. It is recommended that candidates have a knowledge of Latin Grammar, although an examination in it is not required for any courses except the Classical and the Latin-Scientific.

2. *Geography*, general and political.

3. *History of the United States*, including the *Constitution.*

4. *Arithmetic*, including the metric system of weights and measures.

5. *Algebra*, Fundamental Principles. Factoring. Least Common Multiple. Greatest Common Divisor. Fractions. Involution. Evolution. Radicals. Imaginary Quantities. Equations of the First and Second Degrees. Ratio. Proportion and Progressions.

[Olney's University Algebra is recommended, as it is the text-book used in the University.]

6. *Geometry*, Fundamental Principles. Rectilinear Figures. The Circle. Proportional Lines and Similar Figures. Comparison and Measurement of the Surfaces of Rectilnear Figures. Regular Polygons. Measurement of the Circle. Maxima and Minima of Plane Figures, and Plane and Polyhedral Angles; these constituting the subject matter of the first six books of Chauvenet's Geometry.

[Chauvenet's Geometry is recommended, as it is the text-book used in the University.]

7. *Elementary Physics.*

[Avery's Elements of Natural Philosophy (revised edition) is recommended.]

Division of Entrance Examinations.

Candidates for admission to the Freshman Class may pass all the examinations *at once* in June, or in September, or may take them in *two consecutive years.* In the latter case for the Technical courses and the course in Science

and Letters, candidates may present themselves for examination in the first year in the following subjects: English Grammar, Geography, History of the United States, and Arithmetic. No credit will be given unless the candidate has passed satisfactorily in at least three subjects at one examination.

The examinations in Algebra, Geometry and Physics must be passed in June or September of that year in which the candidate proposes to enter the University.

In the Latin-Scientific and Classical courses candidates may present themselves for examination in the first year in the following subjects: English Grammar, Geography, History of the United States, Arithmetic, Physical Geography, and Roman History. No credit will be given unless the candidate has passed at least four of the subjects at one examination.

The examination in Latin may also be divided, but no credit will be given unless the candidate has passed in at least three of the topics specified at one examination. The examination in the remaining subjects must be passed in June or September of that year in which the candidate proposes to enter the University.

Candidates intending to enter the University in September are advised to present themselves for examination in June; if they are not fully prepared at that time they will receive credit for the examinations then satisfactorily passed.

CONDITIONAL ADMISSION.

A candidate failing to pass in one or more of the subjects required for admission may, at the discretion of the Faculty, be admitted to his class conditionally, to make up his deficiencies by extra study. When they are made up, he will be received into full standing in his class.

SPECIAL STUDENTS.

Young men of advanced standing who do not desire to take a full regular course can enter and select special shorter courses, with the sanction of the Faculty; but in all cases satisfactory examinations must be passed upon the subjects required for entrance to the Freshman class.

ADMISSION TO ADVANCED STUDIES.

Candidates for admission to advanced studies *in any course* are required to pass, *in addition to the entrance examinations for that course*, examinations in the work already done by the classes which they desire to enter. These examinations are held on the same days as those for entrance to the Freshman class.

The additional subjects may be found in the program of studies.

A diploma or, in so far as it covers the subjects required for entrance, a certificate of studies taken at another College will be received in lieu of the *Primary Entrance Examinations only.*

ADMISSION TO THE POST GRADUATE COURSE.

Students of this University who have taken their *first* degree, and others, on presenting a diploma of an equivalent degree conferred elsewhere, are admitted to advanced studies, according to the plan to be found in the Register under the general subject of Graduate Students.

PREPARATORY SCHOOL CERTIFICATES

are not accepted so as to dispense with the primary entrance examinations.

NOTE.—The acceptance of a certificate as evidence of proficiency in lieu of examination, is at the discretion of each Professor as to the subjects in his department.

PROGRAM OF STUDIES,

Showing the number of exercises per week for each subject, and the Text-books used.

The following is presented as the general program of instruction, subject to such modifications from time to time as the Faculty may deem expedient, with the approval of the Trustees.

The names of the text-books studied are generally mentioned. The number of exercises per week in each subject is indicated by the figure in parentheses immediately following.

Two hours of Drawing, three of work in the Laboratory, or three of practice in the field, are regarded as equivalent to a recitation or lecture of one hour's duration.

SCHOOL OF GENERAL LITERATURE.

There are three courses in the School of General Literature of the University.

I. The Classical includes all that is prescribed in our best institutions for the degree of Bachelor of Arts (B.A.). It covers full instruction in Greek, Latin, English, French and German, Mathematics, Astronomy, Physics, Chemistry, Geology, Physiology, Hygiene, History, Ethics, Philosophy, Political Economy and Constitutional Law.

II. The Latin-Scientific Course differs from the first in omitting Greek, taking in its place an increased amount of the Modern Languages and of Mathematics. Students completing this Course receive the degree of Bachelor of Science (B.S.).

III. The Course in Science and Letters, for which the same degree is given as for the last mentioned, contains no Latin or Greek, but furnishes instead extended instruction

in French and German, History, General Literature, Mathematics and General Science.

Instruction in all of these courses is given both by recitations and lectures.

DESCRIPTION OF THE COURSES.

GREEK.—During the first term of Freshman year, the class reads several books of the Odyssey, giving attention to Epic forms and syntax, to prosody and scanning and to Homeric antiquities and mythology. The work of the second term is directed towards a thorough acquaintance with the idiom and vocabulary of Attic prose, as a preparation for rapid reading. The Oeconomicus and Symposium of Xenophon and the Crito of Plato are read during the term, with sight readings from the Memorabilia and the Apology; accompanied by discussions of domestic life at Athens. The work of the year includes a thorough review-drill on the principles of Greek accidence and syntax, and exercises in Greek prose composition are required, based, during the second term, on the reading done by the class. Greek history is studied throughout the year, with special reference to the development of political institutions.

The Sophomore class takes up, during the first term, the study of Herodotus and Thucydides. Selections are made from both authors with the purpose of illustrating their best style and at the same time of presenting, from the original sources, the history of certain interesting epochs; the reading from Herodotus, after some drill on the Ionic forms, being in large part at sight. During the second term, the class reads one or two plays of Euripides, with attention to the history of Greek tragedy, the life of the author and the analysis of the drama read. The lyric meters are studied, with the aim of gaining a knowledge of the rhythmical and metrical principles of Greek poetry. During this term an elective course is offered, the subject being Greek oratory, with the reading of certain orations of Lysias or Demosthenes or both.

The Junior year is devoted to a further study of the drama, selected plays of Sophocles, Aristophanes and Æschylus being read during the year. Work is also done in the study of public and private antiquities, partly in lectures by the professor and partly in original investigation on allotted subjects by the students.

During the first term of Senior year, Greek Philosophy is studied with the use of a text-book and with readings from Plato. The second term is in part devoted to the reading of selected odes of Pindar, with careful study of the history of Greek Lyric poetry and of the life and work of Pindar in particular. The course concludes with a review of the history of Greek literature, intended to summarize and harmonize the fragmentary views of the general subject gained from the study of particular authors and departments of literature.

LATIN.—Much of the training in the Freshman year is devoted to laying a good foundation in Latin Grammar and in the translation of English into Latin. The authors studied are used to illustrate both of these, and a large amount is read at sight in order to cultivate quickness and readiness in the student. Roman History is begun, accompanied with full comments and lectures upon points of interest. Collateral reading will also be recommended each year throughout the course. Cicero: De Senectute and De Amicitia or the Philippics, Livy and the Odes and Epodes of Horace are read this year. With the last named, training is given in Latin meters.

During this and the following year, courses of lectures will be given upon Roman Antiquities in addition to a text-book. The topography of Rome with its remains, ancient life in its various aspects, and the other departments of archaeology will be discussed, illustrated by the new and extensive set of magic lantern slides, which have been prepared for this purpose.

The Sophomore year completes the text-book on Roman History. Prose composition is continued, and the subject of Synonyms taken up in connection with it. The Satires

and Epistles of Horace are read in the first term, and in the second the Agricola and Germania, with selections from the Annals of Tacitus, or Quintilian (Bk. X), together with sight reading. An elective in Plautus is offered during this term in addition.

In the Junior year, Selected Letters of Cicero and Pliny are read, followed by Persius and several plays of Terence. The History of Roman Literature is entered upon in the second term.

The work in the Senior year opens with Lucretius, accompanied with lectures on Roman Philosophy. One of Cicero's philosophical treatises, such as the De Officiis, De Finibus, or De Natura Deorum, is taken up in the second term. After the completion of the Roman Literature, lectures will be given upon the History of the Latin Language and upon the Principles of Comparative Philology.

SANSKRIT.—An elementary course in this study, conducted by the Professor of Latin, is offered as an optional during the Senior year.

ENGLISH.—During Freshman and Sophomore years, careful training is given in the writing of essays and in declamation. This is followed, during Junior and Senior years, by exercises in Oratory, with further training in essay writing. Excellence in Oratory is encouraged by the annual contest for the Alumni Prizes, held on the 22d of February and open to the Junior class in all departments.

The second term of Sophomore year takes up the study of Rhetoric, which is pursued with the aid of a text-book and thorough practical exercises.

The History of English Literature and the philological history of the English language are studied during Junior year. These are supplemented by a series of lectures, extending through the first term, on the relations of Literature to History.

The course is completed by a series of lectures on English and American Literature, delivered during the second term of Senior year.

MODERN LANGUAGES.—The study of modern languages is obligatory from the first term of the Sophomore year up to the close of the course. The student elects either French or German, or both, if time permits.

French.—The grammar is begun, reading being introduced immediately. The comparative and historical relations of the French to the English, and the connection of both with the Latin are carefully explained. As soon as possible the student is emancipated from the reader and takes up, in a progressive way, the reading of different authors; preference being given to modern writers, because it is considered to be of the highest importance that he acquire the language as it is, as an instrument whereby further knowledge can be obtained.

In the class-room, the language taught is used by the teacher as much as possible, in order that the ear of the pupil may become accustomed to its sound. Dictation is also employed, in order to give training in spelling. The rules of grammar are taught by numerous written exercises. In the second term of the Junior year, compositions in French are required, upon subjects which have been previously explained in French, in order that the student may become acquainted with different expressions and forms of construction. Before entering upon the study of an author's works, his life and literary achievements are discussed in French, which is translated, if necessary. In the Senior year, twelve lectures are delivered upon the History of French Literature. In addition to this, lectures in French upon the most distinguished modern authors are given to advanced students.

A weekly conversation-class affords opportunity for this kind of practice; and in it the events of the day and various historical and literary topics are discussed. Private courses of reading are also suggested to those who desire it.

German.—The German course follows the same plan as that laid down for the French, both as regards the methods employed and the opportunities afforded. The relations of

English and German are dwelt upon and also those which connect the two languages with the Indo-European family.

MATHEMATICS.—The mathematical work is carried on during the Freshman and Sophomore years as follows:

Freshman year, first term, Chauvenet's Geometry, four exercises per week.

Second term, Olney's University Algebra, Plane and Spherical Trigonometry, including Mensuration and use of Logarithmic Tables, together five exercises per week throughout the term.

Sophomore year, first term, Olney's General Geometry and Davies's Analytical Geometry, four exercises per week.

Second term, Olney's Differential and Integral Calculus, four exercises per week. This term's work is elective for the Classical Course.

ASTRONOMY.—This study is taken up during the first term of the Senior year, Young's General Astronomy being used as the text-book. There are three exercises a week, and visits to the Observatory help to make the work interesting as well as profitable.

CHEMISTRY.—This study includes a complete course of lectures in Freshman year upon General Inorganic Chemistry, in which the principles of the science are fully covered. These are illustrated by experiments, and are sufficiently extended to enable a student who desires to pursue the subject further to take Analytical Chemistry as an elective in the second term of the Sophomore year. The text-book used in connection with the lectures is Fownes' Elementary Chemistry.

PHYSICS.—This important subject is presented in a course of lectures during the first term of the Sophomore year, three times a week. These are illustrated by means of the very complete apparatus of the Physical Laboratory. In the course in Science and Letters, the work in this branch is more extended and is identical with that given to the Civil and Mechanical Engineers. It occupies five hours a week in the first term, when Mechanics, Heat and Elec-

tricity are discussed. Throughout the second term, three hours a week are devoted to Sound, Light and Meteorology.

GEOLOGY.—In the second term of the Senior year, a course of lectures is given in connection with Geikie's text-book. The general principles of the science are explained, and the theories of the formation and stratification of rocks, the successive periods of the development of the earth's crust, the extinct forms of life and similar questions are treated.

PHYSIOLOGY AND HYGIENE.—These subjects are taught in a course of lectures during the Freshman year.

HISTORY, POLITICAL SCIENCE AND LAW.—The study of History begins with a course in the Political Antiquities of Greece and Rome. [See the Departments of Greek and Latin.] This is followed by the study of an outline of Universal History (with text-book), in which it is sought to give a clear view of the relations of ancient and modern states to the world's history. The same aim is then pursued in a fuller study of the Political History of Recent Times, and especially of that of England and France. During the first term of Senior year, there is a course of lectures upon the period covered by Gibbon's Decline and Fall of the Roman Empire, intended to emphasize and strengthen the impression of the interdependence of the nations and of the unity of history. This prepares the way for a course of lectures on the Philosophy of History, in which it is sought to show the relations of the sciences of Biology, Anthropology, Ethnology, Geography and Philology to the study of History and to set forth the scientific methods of that study.

The course in History is accompanied and supplemented by courses of lectures on Constitutional Law with special application to the Constitution of the United States; and also on International Law.

Instruction is given by lectures on the elements of Political Economy. The student is made familiar with the facts, methods and doctrines of the science, and is encouraged to form and present his own opinions.

LOGIC.—In this subject there is an elementary course, occupying two hours a week during the first term of Junior year. The work is done with the aid of a text-book, attention being centered on the principles of correct definition and valid proof.

MORAL PHILOSOPHY.—The course in Moral Philosophy comprises recitations from the text-book, with discussion of ethical theories; followed by studies in the history of morals, using Lecky's History of European Morals from Augustus to Charlemagne. In connection with this course, a full course of lectures is delivered upon the nature and authority of the Christian Evidences.

PSYCHOLOGY.—The course will comprise recitations from the text-book, with general discussion of the most important topics under this subject.

HISTORY OF PHILOSOPHY.—The study of this subject is confined to Senior year. In the study of the History of Greek Philosophy [see Department of Greek], the principal emphasis is laid upon Plato and Aristotle and upon the post-Aristotelian schools. During the second term the course will embrace an historical and critical study of Ancient and Modern Philosophy.

THE COURSE IN SCIENCE AND LETTERS

substitutes the following for the Latin and Greek.

DRAWING.—In the first term of the Freshman year the student is instructed in Elementary Projections, Shading and Lettering.

ZOOLOGY AND BIOLOGY.—The study of these subjects covers one year, beginning with the second term of Sophomore year. The work begins with a description of the various animal functions, and is extended to the comparative anatomy and physiology of the organs in typical species. Systematic Zoology is then completed and followed by the theories of Biology.

CHEMISTRY. — In addition to the Course in General Chemistry described above, three exercises a week in Qualitative Analysis are taken in the second term of the Freshman year.

MINERALOGY.—Instruction in Mineralogy is given to the students in the Course in Science and Letters throughout the Junior year. In the first term, they attend a course of lectures on Crystallography, followed by a series of practical exercises in the determination of crystalline forms by the aid of models and natural crystals.

In the second term a course on the physical properties of minerals and on descriptive mineralogy, with the use of E. S. Dana's Text Book of Mineralogy, is followed by practical exercises in the determination of minerals.

GEOLOGY.—The study of Lithology is pursued in the first term of the Senior year, with laboratory practice, Williams' Lithology being used as the text-book. During the next term, the course given above is taken with the Classical and Latin-Scientific students.

THE CLASSICAL COURSE.

FRESHMAN CLASS.

FIRST TERM.

Mathematics.—Geometry (Chauvenet). (4)
Chemistry.—Lectures. Fownes' Elementary Chemistry. (4)
Greek.—Homer: Odyssey. Prosody. (3)
Latin.—Cicero: de Senectute and de Amicitia. Livy begun. Prose Composition. (2)
History.—History of Greece. (1)
Physiology and Health.—Lectures. (1)
English.—Exercises and Declamations. (1)
Gymnasium. (2)

SECOND TERM.

Mathematics.—Olney's University Algebra, Pt. III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

Greek.—Xenophon: Oeconomicus. (3)

Latin.—Livy completed. Horace: Odes and Epodes. Composition and Prosody. (4)

History.—History of Greece. (2) History of Rome. (1) Roman Antiquities.

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry. Olney's General Geometry. (4)

Physics.—Lectures. (3)

French.—Whitney's Practical French Grammar. Keetel's Analytical Reader. (2) Or *German.*—Brandt's Grammar. Lodeman's Manual of Exercises. Joynes' Otto's Reader. (2)

Greek.—Herodotus and Thucydides. (2)

Latin.—Horace: Satires and Epistles. Composition. (2)

History.—History of Rome. (2) Antiquities.

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

French.—Grammar and Reader (continued). (2) Or *German.*—Grammar, Exercises and Reader (continued). (2)

English.—Coppée's Rhetoric, with Kellogg's Praxis. (1)

History.—Weber's Outlines of Universal History. (2)

Greek.—Euripides: Medea. (3)

Latin.—Tacitus: Agricola, Germania and Annals, or Quintilian: Book X. Composition. (3) Antiquities.

Essays and Declamations. (1)

Gymnasium. (2)

In addition to the above exercises, four hours per week must be selected from the following elective studies:

Mathematics. — Differential and Integral Calculus: Olney. (4)

Greek.—Demosthenes: De Corona. (2)

Latin.—Plautus. (2)

French.—Grammar and Reader. (2)

German.—Grammar and Reader. (2)

Chemistry.—Qualitative Analysis—Laboratory. (2)

JUNIOR CLASS.

FIRST TERM.

History.—Wilhelm Müller's Political History of Recent Times, and Lectures. (2)

Philosophy.—Coppée's Logic. (2)

English.—Coppée's English Literature. (4)

French.—Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

Greek.—Sophocles: Electra. Antiquities. (3)

Latin.—Letters of Cicero and Pliny. (3)

Literature and History. (1)

Gymnasium. (2)

SECOND TERM.

History.—History of England: Hume. (3)

Philosophy.—Hill's Psychology. (2) Political Economy. (1)

English.—Earle's Philology of the English Tongue. (2)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Gasc's Translator. Dictation. (2) Or *German.*—Grammar. Reading. Dictation. (2)

Greek.—Aristophanes: Clouds. Æschylus: Prometheus. (3)

Latin.—Persius and Terence. Cruttwell's History of Roman Literature. (3)

Essays and Original Orations. (1)

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

International Law.—Lectures: Woolsey. (2)

History.—Decline and Fall of the Roman Empire: Gibbon. (3)

Philosophy.—Haven's Moral Philosophy. (2)

Astronomy.—Loomis' Treatise, with Lectures. (3)

French.—Grammar. Saintsbury: Specimens of French Literature. Readings in Corneille, Racine, Molière, etc., and contemporary authors. Compositions. Lectures on French Literature. (2) Or *German.*—Grammar. Readings in Lessing, Herder, Goethe, Schiller, etc., and contemporary authors. Compositions. Lectures on German Literature. (2)

Conversation Class in both languages optional throughout the year.

Greek.—Plato: Phædrus. Greek Philosophy. (2)

Latin.—Lucretius, with Lectures. Roman Literature. (2)

Essays and Original Orations. (1)

Gymnasium. (2)

SECOND TERM.

Constitutional Law.—Lectures. (1)

History.—History of France. (2)

Philosophy.—History of Philosophy. (1) Philosophy of History. Lectures. (2)

Christian Evidences. (1)

French.—Readings. Compositions. Lectures in French on modern French authors. (2) Or *German.*—Readings. Compositions. Lectures in German on modern German authors. (2)

Geology.—Lectures. Geikie. (2)

Greek.—Pindar: Selected Odes. Greek Literature. (2)

Latin.—Cicero: de Officiis, with Lectures. (2)

Lectures on American and English Literature. (2)

Preparation of Thesis.

Gymnasium.

THE LATIN-SCIENTIFIC COURSE.

The Latin-Scientific Course, leading to the degree of Bachelor of Science (B.S.), is based on Latin without Greek.

FRESHMAN CLASS.

FIRST TERM.

Mathematics.—Geometry (Chauvenet completed). (4)

Chemistry.—Lectures. Fownes' Elementary Chemistry. (4)

German.—Joynes-Meissner's Grammar. Joynes-Otto's Reader. (3)

Latin.—Cicero: De Senectute and De Amicitia. Livy begun. Prose Composition. (2)

History.—History of Greece. (1)

Physiology and Health.—Lectures. (1)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of the Logarithmic Tables. (2)

German.—Grammar. Reader (continued). (3)

History.—History of Greece. (2) History of Rome. (1) Roman Antiquities.

Latin.—Livy (completed). Horace: Odes and Epodes. Composition and Prosody. (4)

English.—Exercises and Declamations. (1)

Gymnasium. (2.)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4.)

Physics.—Lectures. (3)

French.—Whitney's Practical French Grammar. Keetel's Analytical Reader. (2)

German.—Grammar. Reading. (2)
History.—History of Rome. (2) Antiquities.
Latin.—Horace: Satires and Epistles. Composition. (2)
English.—Exercises and Declamations. (1)
Gymnasium. (2)

SECOND TERM.

Mathematics. — Differential and Integral Calculus: Olney. (4)
English.—Coppée's Rhetoric, with Kellogg's Praxis. (1)
French.—Grammar. Reader (continued). (2)
German.—Grammar. Reading. Dictation. (2)
History.—Weber's Outlines of Universal History. (2)
Latin.—Tacitus: Agricola, Germania and Annals, or Quintilian: Book X. Composition. (3) Antiquities.
Essays and Declamations. (1)
Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

History.—Wilhelm Müller's Political History of Recent Times, and Lectures. (2)
Philosophy.—Coppée's Logic. (2)
English.—Coppée's English Literature. (4)
French.—Grammar. Reading. (2)
German.—Readings in Lessing, Herder, Goethe, Schiller and contemporary authors. Dictation. Compositions. (2)
Conversation Class in German optional throughout the year.
Latin.—Letters of Cicero and Pliny. (3)
Literature and History. (1)
Gymnasium. (2)

SECOND TERM.

History.—History of England: Hume. (3)
Philosophy. — Hill's Psychology. (2) Political Economy. (1)

English. — Earle's Philology of the English Tongue. (2)

French. — Grammar. O'Connor: Choix de Contes Contemporains. Gasc's Translator. Dictation. (2)

German. — Readings (continued). Dictation. Compositions. (2)

Latin. — Persius, Terence. Cruttwell's History of Roman Literature. (3)

Essays and Original Orations. (1)

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

International Law.—Lectures: Woolsey. (2)

History. — Decline and Fall of the Roman Empire: Gibbon. (3)

Philosophy.—Haven's Moral Philosophy. (2)

Astronomy.—Loomis' Treatise, with Lectures. (3)

French.—Saintsbury: Specimens of French Literature. Readings in Corneille, Racine, Molière, etc., and contemporary authors. Lectures on French Literature. (2)

German.—Readings (continued). Compositions. Lectures on German Literature. (1)

Conversation Class in both languages optional throughout the year.

Latin.—Lucretius, with Lectures. Roman Literature. (2)

Essays and Original Orations. (1)

Gymnasium.

SECOND TERM.

Constitutional Law. — Lectures. (1)

History.—History of France. (2)

Philosophy. — History of Philosophy. (1) Philosophy of History. Lectures. (2)

Christian Evidences. (1)

Geology.—Lectures. Geikie. (2)

Latin.—Cicero: de Officiis, with Lectures. (2)

French.—Readings (continued). Compositions. Lectures in French on modern French authors. (2)

German.—Readings (continued). Compositions. Lectures in German on modern German authors. (1)

Lectures on American and English Literature. (2)

Preparation of Thesis.

Gymnasium.

COURSE IN SCIENCE AND LETTERS.

The Course in Science and Letters, leading to the Degree of Bachelor of Science (B.S.), is designed for those who wish to pursue both Scientific and Literary studies without Latin and Greek. These being omitted, extended instruction is given in French and German, History, General Literature, Mathematics and General Science.

FRESHMAN CLASS.

FIRST TERM.

Mathematics.—Geometry, (Chauvenet completed.) (4)

Chemistry.—Lectures. Fownes' Elementary Chemistry. (4)

German.—Joynes-Meissner's Grammar. Joynes-Otto's Reader. (3)

Drawing.—Elementary Projections, Shading and Lettering. (2)

History.—History of Greece. (1)

Physiology and Health.—Lectures. (1)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of the Logarithmic Tables. (2)

Chemistry.—Qualitative Analysis. (3)

History.—History of Greece. (2) History of Rome. (1)

German.—Grammar. Reader (continued). (3)
English.—Exercises and Declamations. (2)
Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)
Physics.—Mechanics, Heat and Electricity. Lectures. (5)
French.—Whitney's Practical French Grammar. Keetel's Analytical Reader. (2)
German.—Grammar. Readings. (2)
History.—History of Rome. (2)
English.—Exercises and Declamation. (1)
Gymnasium. (2)

SECOND TERM.

Mathematics. — Differential and Integral Calculus: Olney. (4)
Physics.—Sound, Light and Meteorology. Lectures. (3)
English.—Coppée's Rhetoric, with Kellogg's Praxis. (1)
French.—Grammar. Readings (continued). (2)
German.—Grammar. Readings. Dictation. (2)
History.—Weber's Outlines of Universal History. (2)
Essays and Declamations. (1)
Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

History.—Wilhelm Müller's Political History of Recent Times, and Lectures. (2)
Philosophy.—Coppée's Logic. (2)
English.—Coppée's English Literature. (4)
French.—Grammar. Readings. (2)

German.—Readings in Lessing, Herder, Goethe, Schiller and contemporary authors. Dictation. Compositions. (2)

Conversation Class in German optional throughout the year.

Zoology.—Lectures and Laboratory work. Tenney. (2)

Crystallography. — Lectures, with practical exercises in the determination of Crystals. (2)

Literature and History. (1)

Gymnasium. (2)

SECOND TERM.

History.—History of England: Hume. (3)

Philosophy.—Hill's Psychology. (2) Political Economy. (1)

English.—Earle's Philology of the English Tongue. (2)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Gasc's Translator. Dictation. (2)

German.—Readings (continued). Compositions. (2)

Mineralogy.—Descriptive Mineralogy, with practical exercises in the determination of Minerals. (3)

Essays and Original Orations. (1)

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

International Law.—Lectures: Woolsey. (2)

History.—Decline and Fall of the Roman Empire. (3)

Philosophy.—Haven's Moral Philosophy. (2)

Astronomy.—Loomis' Treatise, with Lectures. (3)

French.—Saintsbury: Specimens of French Literature. Readings in Corneille, Racine, Molière, etc., and contemporary authors. Compositions. Lectures on French Literature. (2)

German.—Readings (continued). Compositions. Lectures on German Literature. (1)

In both languages, Conversation Class optional throughout the year.

Geology.—Williams' Lithology and Laboratory Practice. (2)

Essays and Original Orations. (1)

Gymnasium.

SECOND TERM.

Constitutional Law.—Lectures. (1)

History.—History of France. (2)

Philosophy.—History of Philosophy. (1) Philosophy of History. Lectures. (2)

Christian Evidences. (1)

French.—Readings (continued). Compositions. Lectures in French on modern French authors. (2)

German.—Readings (continued). Compositions. Lectures in German on modern German authors. (1)

Geology.—Historic, Dynamic and Economic Geology. Geikie. (2)

Lectures on American and English Literature. (2)

Preparation of Thesis.

Gymnasium.

THE SCHOOL OF TECHNOLOGY.

This School includes six distinct courses:

I. The Course in Civil Engineering.
II. The Course in Mechanical Engineering.
III. The Course in Mining and Metallurgy.
IV. The Course in Electrical Engineering.
V. The Course in Chemistry.
VI. The Course in Architecture.

These have the same curriculum of studies for the first term of the Freshman year. At the end of that time the student selects his course and follows its program.

FRESHMAN CLASS.

FIRST TERM.

Mathematics.—Chauvenet's Geometry (completed). (4)
Chemistry.—Lectures. Fownes' Elementary Chemistry. (4)
French.—Chardenal, First Course. Keetel's Analytical Reader. (3) Or *German.*—Joynes-Meissner's Grammar. Joynes-Otto's Reader. (3)
Drawing.—Free Hand Sketching and Lettering. (2)
English.—Exercises and Declamations. (2)
Physiology and Health.—Lectures. (1)
Gymnasium. (2)

THE COURSE IN CIVIL ENGINEERING.

The special technical studies in this course may be grouped under the heads of Surveying, Applied Mechanics, Road and Railroad Construction, Bridge Design, and Hydraulic and Sanitary Engineering.

The work in Surveying extends over seven terms and embraces land surveying, leveling, topography, triangulation, railroad reconnaissance and location, hydrography, and the elements of geodesy. A large equipment of transits, levels and other surveying tools, affords students the opportunity of becoming familiar with the instruments of different manufacturers. Much time is devoted to practice in the field and drafting room, each student being required to become proficient in the use of instruments, in taking field notes, and in map drawing. Particular attention is paid to the execution of topographical surveys and maps by the best modern methods. During the senior year there is done secondary triangulation work of a high order of precision.

The work in Applied Mechanics comprises the strength and elasticity of materials, the theory of the equilibrium of arches, roofs and bridges, that part of the mechanics of machinery which relates to locomotives and hoisting machines, and the theory of hydraulics and hydraulic motors. Here the theoretical principles are illustrated by examples and problems taken as far as possible from actual engineering practice and a special report is required from

each student on the testing machines of the Bethlehem Iron Company.

The course in Construction familiarizes the student with the qualities of materials used in engineering structures, with methods of preservation and testing, with masonry and foundations, and with the building and maintenance of roads and railroads. Plans, drawings, and estimates of cost are prepared for the construction of a line of railroad, all details, such as drains, culverts, road crossings, etc., being worked out by each student.

The course in Bridge Design is preceded by the theory of computation of stresses by both analytical and graphic methods. Starting with the specifications for a first-class iron highway or railroad bridge, each student then makes the full computations, designs, working drawings, and bills of material for a plate girder and for a pin connected truss bridge. The weight of the designed bridge is finally determined and compared with the dead load assumed for the calculations. The drawings are made and dimensioned in the same manner as in the drafting office of a bridge company. In connection with this course, visits of inspection to bridges in the vicinity are regularly made.

The work in Hydraulic and Sanitary Engineering embraces the study of systems of water supply, the collection, purification and distribution of water, the combined and the separate systems of sewerage, the methods for the disposal of sewage, and the best practice for the drainage and ventilation of houses. The hydraulic laboratory in the University Park affords opportunity for experiments on the actual measurement of water by means of weirs and orifices, and the testing of hydraulic motors.

Besides these special studies there is a course in Astronomy which includes practical work in the observatory. The study of English, and of French or German, is continued, and instruction is given during four terms in Crystallography, Mineralogy, Lithology and Geology.

The student who completes all the studies of this course will receive the degree of Civil Engineer (C.E.)

FRESHMAN CLASS.

FIRST TERM.

See page 59.

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

Surveying.—Theory of Chain and Compass Surveying. Computation of Areas. Elements of Leveling. (1)

French.—Chardenal, Second Course. (Reader continued). (3) Or *German.*—Grammar and Reader (continued). (3)

Drawing.—Projection Drawing and Descriptive Geometry. Warren's Elementary Projection Drawing. (4)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)

Physics.—Mechanics, Heat, and Electricity. Lectures. (5)

French.—Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

Drawing.—Isometric Drawing. Architectural Drawing. (2)

Surveying.—Use of the Compass, Level and Transit. Surveys and Maps of Farms. Colored Topography. (2)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics.—Differential and Integral Calculus: Olney and Courtenay. (4)

Physics.—Sound, Light and Meteorology. Lectures. (3)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Dictation. (2) Or *German.*—Grammar. Reading. Dictation. (2)

Mechanics.—Theory of motion, statics, energy, center of gravity, moment of inertia and general equations of motion. (4)

Surveying.—Profiles and Contour Maps. Hydrographic and City Surveying. Use of the Plane Table. Topographical Drawing. (3)

Essays and Declamations.

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Courtenay's Calculus, and Wood's Analytical Mechanics. (2)

French.—Readings. Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation Class in both languages optional throughout the year.

Surveying.—Triangulation. Leveling. Topographical Surveying with Transit and Stadia. Topographical Map. (4)

Strength of Materials.—Elasticity and Strength of Wood, Stone, and Metals. Theory of Columns, Shafts and Beams. Reports on the Testing of Materials. (4)

Construction.—Materials of Construction. Masonry. Foundations. Construction of Roads and Pavements. (2)

Crystallography.—Lectures, with practical exercises in the determination of Crystals. (2)

Literature and History. (1)

Gymnasium. (2)

SECOND TERM.

French.—Readings. Compositions. Lectures on French Literature. (2) Or *German*—Readings. Compositions. Lectures on German Literature. (2)

Surveying.—Theory of Railroad Curves. Railroad Reconnaissance and Location. Survey of a Line, with Profile, Map and Estimate of cost. (4)

Roofs and Bridges.—Theory and Calculation of Strains in Roof and Bridge Trusses. Graphical Statics. (3)

Construction.—Stone cutting, with practical Drawings. (2) Construction and Maintenance of Railroads. Theory of Retaining Walls and Stone Arches. (2)

Mineralogy.—Descriptive Mineralogy, with practical exercises in the Determination of Minerals. (3)

Essays and Original Orations.

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Astronomy.—Loomis' Treatise, with Lectures. (3)

Bridges.—Suspension, Continuous and Cantilever Bridges. Design of Plate Girders and Riveted Bridges, with Working Drawings. (6)

Surveying.—Use of Solar Transit and Sextant. Precise Triangulation. Elements of Geodesy. The Figure of the Earth. (3)

Mechanics of Machinery.—Pile Drivers, Cranes, and Elevators. The mechanics of the Locomotive. (2)

Geology.—Williams' Lithology, with practical exercises in determining rocks. (2)

Gymnasium.

SECOND TERM.

Astronomy.—Doolittle's Practical Astronomy, with Observatory Work. (2)

Bridges.—Design of Pin Connected Bridges, with Working Drawings. (3)

Hydraulics.—Hydrostatics. Efflux of water from orifices, and flow in pipes and rivers. Hydraulic motors. (2)

Hydraulic and Sanitary Engineering.—Collection, Purification and Distribution of Water. Systems of Water Supply. The Combined and the Separate System of Sewerage. Disposal of Sewage. House Drainage. Hydraulic Experiments. (4)

Geology.—Historic and dynamic. Geikie. (2)
Lectures on English Literature. (2)
Christian Evidences.—Lectures. (1)
Preparation of Thesis.
Gymnasium.

THE COURSE IN MECHANICAL ENGINEERING.

The object of this course is the study of the Science of Machines; the principal subjects taught are: the nature, equivalence and analysis of mechanisms, the mechanics or theory of the principal classes or types of machinery, Mechanical Technology and the principles and practice of Machine Design.

That the students may obtain the practical engineering data which they will most need when beginning their work as mechanical engineers, they are required to pursue a course of Shop Instruction which does not necessarily involve manual labor and manipulation of tools, but is principally devoted to familiarizing them with those points in pattern-making, moulding, forging, fitting and finishing, which they need to know as designers of machinery. Particular attention is therefore directed to the forms and sizes of machine parts that can be readily constructed in the various workshops, to the time that it takes to perform, and the order of, the various operations, to the dimensions most needed by workmen and to the various devices for increasing the accuracy of the work, durability of the parts and convenience of manipulation. This involves acquaintance with the processes and machinery of the workshops, but it is the foreman's and superintendent's knowledge which is required rather than the manual dexterity and skill of the workman and tool hand. The acquirements peculiar to the latter are by no means despised, and students are encouraged to familiarize themselves therewith during leisure hours, but manual work in the shops forms no regular part of the course. On the contrary, the student enters the shop

with hands and mind free to examine all the processes, operations and machinery, and is ready at the call of the teacher to witness any operation of special interest. Provided with note-book, pencil, calipers and measuring rule, the student sketches the important parts of the various machine-tools, notes down the successive steps of each of the important shop-processes as illustrated by the pieces operated upon, and follows pieces of work through the shops from the pig or merchant form to the finished machine.

That the students may learn to observe carefully and be trained to think and observe for themselves in these matters, there is required of them a full description of the various processes, operations and tools involved in the production of each one of a series of properly graded examples of patterns, castings, forgings and finished pieces which are not being constructed in the shops at the time and the blue prints for which have been given to them on entering the shops. The student's work is directed not only by these drawings and by the printed program given him at the start, but also personally by a teacher, who accompanies him into the shops, gives necessary explanations, and tests the extent and accuracy of his knowledge by examining the sketches and notes and by frequent questioning. Finally the results of the observations and the sketches are embodied in a memoir.

During the course there are frequent visits of inspection to the Bethlehem Iron Co., the L. V. R. R. Shops at Easton, and other engineering works both in and out of town, with special reference to such subjects as Machine Elements, Prime Movers, Machinery for lifting, handling and transporting, and Machinery for changing the form and size of materials. It is intended that each of these excursions shall have some definite purpose in view which must be fully reported by the students. These visits are also made the occasion for constant practice in the Free Hand Sketching of Machinery.

The instruction in Machine Design begins with second term of the Freshman year and is continued throughout

the course. At first tracings of good examples of machine drawings are made; then there is considerable drill in the interpretation of such drawings and general views of lathes, planers, drills and shapers are made from the drawings of the details. This is followed by difficult projections and intersections and exercises in the empirical proportioning of machine parts. Both empirical and rational formulas are used to determine the dimensions of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers and connecting rods, the data being given as they would arise in practice and the drawings made full size. During the Junior year the class takes up the design of a high speed steam engine, every dimension being determined by the students and complete drawings made. During the Senior year the students undertake the calculations, estimates and working drawings involved in the design of a simple but complete machine, each student being engaged upon a different machine. From the finished drawings of each machine, tracings are made and then blue prints taken for distribution among the other members of the class. In the case of the machines and of the engine, the general plan or arrangement will be given to the students in the form of rough sketches, photographs or wood-cuts. In the last term the students are expected to make original designs for simple machinery, whose object has been fully explained. Throughout the course the work in the draughting room is carried on as nearly as possible like that of an engineering establishment, and special attention is paid to methods of expediting the work of calculation by means of simple formulas, tables and diagrams.

The graduate in this course will receive the degree of Mechanical Engineer (M.E.).

FRESHMAN CLASS.

FIRST TERM.

See page 59.

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

French.—Chardenal, Second Course. Reader (continued). (3) Or *German.*—Grammar and Reader (continued). (3)

Drawing and Machine Design.—Tracings. Interpretation of machine drawings by isometric sketches. General views from given details. Sections of stub ends and valve passages. Intersection of boiler flues. Empirical proportioning of machine parts. (5)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)

Physics.—Mechanics, Heat and Electricity. Lectures. (5)

Machine Design.—Proportioning of such machine parts as come under the head of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers and connecting rods. (2)

Visits of Inspection.—Examination and sketching of principal machine parts in the shops of the vicinity. (2)

French.—Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics. — Differential and Integral Calculus: Olney and Courtenay. (4)

Physics.—Sound, Light and Meteorology. Lectures. (3)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Dictation. (2) Or *German.* — Grammar. Reading. Dictation. (2)

Mechanics.—Theory of motion, statics, energy, center of gravity, moment of inertia and general equations of motion. (4)

Steam Engine.—Holmes's Steam Engine. (3)

Essays and Declamations. (1)

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Courtenay's Calculus and Wood's Analytical Mechanics. (2)

French.—Readings. Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation Class in both languages optional throughout the year.

Mechanical Technology.—Shop instruction. Examination of the processes and appliances involved in pattern making, moulding, forging, fitting and finishing, with sketches and reports. (7)

Boilers.—Wilson. Strength, construction and wear and tear of boilers. (1)

Strength of Materials.—Elasticity and strength of wood, stone and metals. Theory of beams, shafts and columns. Reports on experimental tests. (4)

Literature and History. (1)

Gymnasium. (2)

SECOND TERM.

French.—Readings. Compositions. Lectures on French Literature. (2) Or *German.* — Readings. Compositions. Lectures on German Literature. (2)

Kinematics of Machinery. Reuleaux. Nature and Equivalence of Mechanisms. (3)

Machine Design.—Calculations and Working Drawings for a High Speed Steam Engine. (5)

Metallurgy.—Metallurgical Processes. Furnaces. Refractory Building Materials. Combustion. Natural and Artificial Fuels. Metallurgy of Iron. (4)

Machinery of Transmission.—Weisbach-Herrmann. (2)

Essays and Original Orations.

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Thermodynamics.—General principles; application to Steam Engines and Air Compressors. (3)

Graphical Statics.—Graphical Analysis of Roof Trusses and Girders. (2)

Machine Design.—Calculations and working drawings for hoisting, pumping and metal-working machinery. (4)

Kinematics.—Diagrams of the changes of position, speed and acceleration in mechanisms. Link and valve motions. Quick return motions. Parallel motions. Laying out of Cams. (3)

Mechanics of Machinery.—Weisbach-Herrmann. Hoisting machinery, accumulators, cranes and locomotives. (4)

Gymnasium.

SECOND TERM.

Mechanics of Machinery.—Weisbach-Herrmann. Pumps, pumping engines, blowing engines, compressors and fans. (4)

Machine Design.—Original Designs. (5)

Hydraulics.—Hydrostatics. Flow of water in pipes and channels; hydraulic motors. (2)

Measurement of Power.—Indicating of Steam Engines; determination of evaporative efficiency of boilers; dynamometer experiments. (1)

Lectures on American and English Literature. (2)

Christian Evidences.—Lectures. (1)

Preparation of Thesis.

Gymnasium.

THE COURSES IN MINING AND METALLURGY.

These courses aim to fit the student for practical work in either of the branches of mining, metallurgy, metallurgical chemistry, or geology. On account of the great number and scope of the studies necessary to the attainment of the degree of Engineer of Mines (E.M.), which includes that of Metallurgist, five years are required. At the end of the fourth year, the student will have completed a course similar to that leading to the scientific degree in other institutions, and will receive the degree of Bachelor of Science (B.S). At the end of the freshman year an opportunity is given the student to select one of two courses leading to the above degrees. These allow a full course in either mining or metallurgy to be acquired in four years, and afford to the student whose time is limited and who desires to practice one of the above branches, the means for rapid work. The graduate in either course can obtain the engineer's degree (E.M.) by one year of post-graduate work. The following program of subjects and studies shows the requirements for the degree of Engineer of Mines.

Modern Languages.—Although the option of studying French or German lies with the student, it may be well to note that the current literature of the subjects taught in these courses is more abundant in the latter language.

Drawing and Construction.—The course in machine design begins in the second term of Freshman year with tracings of good examples of machine drawings; then follow the interpretation of such drawings, and the making of general views of machines from detailed sketches; exercises in projection drawing from the same, and the proportioning of simple tools and machines. In Sophomore year the metallurgist becomes acquainted with the arrangement and details of metallurgical plant and in Senior year he designs the same. The post-graduate, during the entire year, becomes acquainted with and designs mining plant. The field work in mining and geological surveying is followed by map construction from field notes. Practice in

mining and metallurgical construction is also afforded by the projects.

CHEMISTRY. — The course in theoretical and applied chemistry extends over three years and includes work in wet and dry assaying of all the important ores and metallurgical products met with in actual practice, combined with the working of stoichiometric problems and the study of chemical philosophy. The practical work is that required for a metallurgical chemist or assayer.

With moderate care the expenses in this department need not exceed $120.

MINERALOGY. — This subject is divided into two courses. In the first course, after a short exposition of the laws of crystallography and a description of crystalline forms, practical exercises are held in the determination of simple and complex crystals, in which the student is taught to identify the various crystalline forms observed in minerals by the aid of models and of actual crystals, and with the use of the application goniometer. The second course includes the subjects of physical, descriptive and determinative mineralogy. As in the first course, the greater part of the time is devoted to practical exercises which, in this course, have for their object the determination of minerals. Each student is thus enabled to become familiar with the more common minerals by the actual handling of several hundred specimens, with the facility of making such tests as will not injure them. The presence of one or more instructors during each exercise permits the student to make frequent reports of his determinations, and to receive much instruction as to the characteristics of the minerals. The knowledge thus acquired can be supplemented by visits to the museum.

The courses in blowpipe analysis may be considered as auxiliary to the practical exercises in determinative mineralogy. In the latter the student is urged to rely chiefly on physical tests ; in the former he is required to determine minerals by the aid of the blowpipe.

The mineralogical laboratory offers facilities for an advanced course in crystallography and in physical and microscopic mineralogy to a few students who may receive permission to pursue such a course.

GEOLOGY.—This subject is studied with special reference to the needs of the mining engineer. Within a radius of twenty miles the student meets and becomes acquainted with the rocks of the archæan, the palæozoic and mesozoic formations, and makes geological maps from his own field notes, paying attention to the lithological characters of the formations, as they are mainly non-fossiliferous. An extended practical course in lithology familiarizes the student with the rocks of importance to the mining engineer and enables him to determine them by sight. There are over 2000 specimens in the collection, embracing all the known species. The course in historic geology is illustrated by a cabinet of typical specimens. The course in economic geology supplements the above work by familiarizing the student with the geological horizon of all the valuable constituents of the earth's crust and the theories of their formation.

ASTRONOMY.—After studying the theory of the subject, two thirds of the year are devoted to practical work in the observatory.

APPLIED MECHANICS.—This embraces hydraulics, a study of the steam engine and the mechanics of machines employed in mining and metallurgy.

SURVEYING.—A course extending over five terms offers practice in land, mine and geological surveying, leveling, topography, triangulation, and railroad reconnaissance and location. It also includes practical work in drawing and map construction.

METALLURGY.—There are two courses of, together, about one hundred and forty lectures upon this subject, which extend throughout a year. In these the chief object kept in view is a clear presentation of the principles involved in

the various metallurgical processes, looked upon as the application to practice of the laws of chemistry, physics and mechanics. This is followed, in the case of each process, by a description of the more important examples of the plant and of the methods of conducting the process, and by indications concerning its economic features. In order to ensure that the student shall understand the fundamental principles of metallurgy, and shall become so familiar with them as to be able readily to apply them, he is required to solve a series of problems in which these principles are involved. Many of the problems are such as are likely to present themselves to the metallurgist in his current practice.

The metallurgical laboratory affords opportunity for special investigations in subjects connected with metallurgy to such advanced students as are competent to conduct them.

MINING.—This subject is covered by three courses. The first begins with the application of economic geology to the needs of the engineer, so that he can study and value mining properties, locate appropriately the necessary plant, and calculate the cost of production. It includes the discussion of faults and the means of finding faulted bodies, with practical problems. The subjects of blasting, timbering and winning deposits are applied to actual cases, as tunnel driving, etc., and problems from practical data are solved by the students. The second course covers the subjects of underground and surface haulage ; loading, unloading and stocking ores ; pumping ; ventilation ; hygiene and mining law. A series of problems are given in each of these subjects to cover cases that meet the engineer in ordinary practice. The third course treats of the mechanical preparation of ores by the wet, dry, or magnetic methods, and especially of the preparation of anthracite coal.

The location of the university in the vicinity of the iron works of the Lehigh Valley and especially of the extensive establishment of the Bethlehem Iron Company, affords unusual facilities for the practical study of iron metallurgy. The processes for the manufacture of spelter and oxide of

zinc may be studied at the Bethlehem Zinc Works. The facilities for the practical study of mining and economic geology are not excelled by those of any other Institution in the country. The zinc mines at Friedensville, the paint ores of the Marcellus formation, and the brown hematite and slate deposits of the Lehigh Valley are in the immediate vicinity, while within easy reach by rail are the semi-bituminous and anthracite coal fields, the block and fossil iron ores of the Clinton measures, the iron mines at Cornwall, Pennsylvania, and the iron and zinc mines of New Jersey; together affording examples of nearly all the methods of winning and dressing valuable deposits. Numerous visits of inspection are made in connection with the work of the course, to familiarize the student with metallurgical and mining processes and afford data for practical examples and projects.

FRESHMAN CLASS.

FIRST TERM.

See page 59.

SECOND TERM.

Mathematics.—Olney's University Algebra, Pt. III. (3) Plane and spherical trigonometry and mensuration. Use of logarithmic tables. (2)

French.—Chardenal, Second Course. Reader (continued). (3) Or *German.*—Grammar and Reader (continued). (3)

Machine and Mining Drawing.—Tracings. Interpretation of machine drawings by isometric sketches. General views from given details. Sections of stub ends and valve passages. Intersection of boiler flues. Empirical proportioning of machine parts. Graphical problems illustrating the direction and extent of throw in faults. (5)

Surveying.—Theory of chain and compass surveying. Computation of areas. Elements of leveling. (1)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

THE COURSE IN METALLURGY.

This course is arranged so that the subjects which prepare the student for practice in the field of metallurgy shall be completed at the end of four years, when the graduate will receive the degree of Bachelor of Science in Metallurgy (B.S). By remaining a year longer, and taking the subjects laid down for the post-graduate year, the graduate in this course may obtain the degree of Engineer of Mines (E.M.).

SOPHOMORE CLASS.

FIRST TERM.

Mathematics. — Analytical Geometry: Olney's General Geometry. (4)

Physics.—Mechanics, heat and electricity. Lectures. (5)

French. – Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

Drawing.—General views of metallurgical plant and detailed sketches. (2)

Surveying.—Use of the Level and Transit. Surveys and maps of farms. Colored topography. (2)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics.—Differential and Integral Calculus: Olney and Courtenay. (4)

Mechanics.—Theory of motion, statics, energy, center of gravity, moment of inertia and general equations of motion. (4)

Chemistry. – Lectures and laboratory practice. Douglass and Prescott's Qualitative Analysis. (4)

Stoichiometry. (2)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Dictation. (2) Or *German.* – Grammar. Reading. Dictation. (2)

Essays and Declamations.

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Mathematics. – Courtenay's Calculus and Wood's Analytical Mechanics. (2)

Strength of Materials. — Elasticity and strength of wood, stone and metals. Theory of beams, columns and shafts. (4)

Crystallography. — Lectures, with practical exercises in the determination of crystals. (2)

Assaying. – Including the assay by the dry methods of Gold, Silver, Antimony, Mercury, Lead, Iron and Tin ores. Laboratory Work. Ricketts. (3)

Chemical Philosophy. – Cooke. (3)

French.—Readings. Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation class in both languages optional throughout the year.

Literature and History.

Gymnasium. (2)

SECOND TERM.

Metallurgy.—Metallurgical Processes. Furnaces. Refractory building materials. Combustion. Natural and artificial fuels. Metallurgy of Iron. (4)

Mineralogy. — Descriptive mineralogy, with practical exercises in the determination of minerals: E. S. Dana. (3)

Blow-Pipe Analysis.— Lectures, with practice. Plattner, Brush, or Nason and Chandler. (1)

Chemistry. —Fresenius' Quantitative Analysis. (4) The following analyses are executed by the student:

1. Iron Wire (Fe)
2. Copper Ore (Cu)
3. Silver Coin (Au, Ag, Pb, Cu)
4. Zinc Ore (Zn) By both Gravimetric and Volumetric Methods.
5. Bronze (Cu, Sn, Zn, Pb)
6. Spiegeleisen (Mn)
7. Lead Ore (PbS)

8. Ilmenite (TiO_2)
9. Iron Ore (Complete Analysis)
10. Limestone (Complete Analysis)
11. Coal (Volatile Matter, Fixed Carbon, Ash, H_2O, S, P)

Steam Engine.—Holmes's Steam Engine. (3)

French.—Readings. Compositions. Lectures on French Literature. (2) Or *German.*—Readings. Compositions. Lectures on German Literature. (2)

Essays and Original Orations.

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Metallurgy.—Of Copper, Lead, Silver, Gold, Platinum, Mercury, Tin, Zinc, Nickel, Cobalt, Arsenic, Antimony and Bismuth. (5)

Blow-pipe Analysis.—Practice. (1)

Lithology.—Williams' Lithology, with practical exercises in determining rocks. (3)

Mechanics of Machinery.—Weisbach-Herrmann. Hoisting machinery, accumulators, cranes. (2)

Chemistry.—Quantitative Analysis: Laboratory Work: Fresenius. (3) The following analyses are executed by the student:

12. Slag (Complete Analysis)
13. Pig Iron (Complete Analysis)
14. Carbon in Steel (Volumetric)
15. Nickel Ore (Ni, Co)
16. Gas Analysis.

Graphical Statics.—Graphical analysis of roof trusses and girders. (2)

Projects.—In metallurgy. (1)

Gymnasium.

SECOND TERM.

Mining.—Mechanical Preparation of Ores. Coal Washing. Callon. Lectures. (2)

Geology.—Economic geology. Lectures. Williams. (2)

Drawing. — Designing of furnaces and other metallurgical plant. (2)

Mechanics of Machinery. — Pumps, pumping-engines, blowing-engines, compressors and fans. (4)

Hydraulics. – Hydrostatics. Flow of water in pipes and channels. Hydraulic motors. (2)

Lectures on American and English Literature. (2)

Christian Evidences.—Lectures. (1)

Preparation of Thesis.

Gymnasium.

POST-GRADUATE YEAR.

FIRST TERM.

Mining. — Modes of occurrence of the useful minerals. Searching for mineral deposits. Examination of mining properties. Boring. Mining tools, machines and processes. Timbering and masonry. Methods of working. Callon. André. Lectures. (3)

Geology.—General geological definitions and principles. Dynamic geology. Dana. (2)

Drawing.—General views of mining plant and detailed sketches. (2)

Projects.—In geology and mining. (1)

Surveying. – Mine survey. Theory and practice, with construction of mine maps. Tunneling and shaft location. (2)

Astronomy.—Descriptive astronomy: Loomis. (3)

Surveying. — Triangulation. Leveling. Topographical surveys with transit and stadia. Topographical maps. (4)

SECOND TERM.

Mining.— Underground transportation. Hoisting, drainage and pumping. Ventilation and lighting. Hygiene of mines. Mining law. (3)

Geology. —Historic geology. Dana. (2)

Surveying. –Geological survey: Mapping and cross-sectioning. (2)

Drawing.—Designing of mining plant. (2)

Surveying.—Theory of railroad curves. Railroad reconnaissance and location. Survey of a line, with profile, map and estimate of cost. (4)

Astronomy.—Doolittle's Practical Astronomy, with observatory work. (2)

Preparation of Thesis.

THE COURSE IN MINING.

This course is designed so that the student who desires to pursue the practice of mining and ore-dressing, and who does not wish to take the full course, may be prepared for practice in four years, receiving the degree of Bachelor of Science in Mining (B.S.). By remaining a year longer, and taking the subjects laid down for the post-graduate year, the graduate in this course may obtain the degree of Engineer of Mines (E.M.).

This course is identical with the preceding up to the end of the Freshman year.

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)

Physics.—Mechanics, heat and electricity. Lectures. (5)

French.—Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

Crystallography.—Lectures, with practical exercises in the determination of crystals. (2)

Surveying.—Use of the level and transit. Surveys and maps of farms. Colored topography. (2)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics.—Differential and Integral Calculus: Olney and Courtenay. (4)

Mechanics.—Theory of motion, statics, energy, center of gravity, moment of inertia and general equations of motion. (4)

Chemistry.—Lectures and laboratory practice. Douglass and Prescott's Qualitative Analysis. (4)

Mineralogy.—Descriptive mineralogy, with practical exercises in the determination of minerals: E. S. Dana. (3)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Dictation. (2) Or *German.*—Grammar. Reading. Dictation. (2)

Essays and Declamations.

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Courtenay's Calculus and Wood's Analytical Mechanics. (2)

Strength of Materials.—Elasticity and strength of wood, stone and metals. Theory of beams, columns and shafts. (4)

Geology.—General geological definitions and principles. Dynamic geology. Dana. (2)

Lithology.—Williams' lithology, with practical exercises in determining rocks. (3)

Surveying.—Triangulation. Leveling. Topographical surveys with transit and stadia. Topographical maps. (4)

French.—Readings. Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation class in both languages optional throughout the year.

Literature and History.

Gymnasium. (2)

SECOND TERM.

Geology. — Historic and Economic Geology. Lectures. Dana. (4)

Blow-Pipe Analysis.—Lectures, with practice. Plattner, Brush, or Nason and Chandler. (1)

Surveying.—Geological survey: Mapping and cross-sectioning. (2)

Steam Engine.—Holmes's Steam Engine. (3)

Surveying.—Theory of railroad curves. Railroad reconnaissance and location. Survey of a line, with profile, map and estimate of cost. (4)

French.—Readings. Compositions. Lectures on French Literature. (2) Or *German.* — Readings. Compositions. Lectures on German Literature. (2)

Essays and Original Orations.

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Mining.—Modes of occurrence of the useful minerals. Searching for mineral deposits. Examination of mining properties. Boring. Mining tools, machines and processes. Timbering and masonry. Methods of working. Callon. André. Lectures. (3)

Mechanics of Machinery.—Weisbach-Herrmann. Hoisting machinery, accumulators, cranes. (2)

Astronomy.—Descriptive astronomy: Loomis. (3)

Surveying.—Mine survey. Theory and practice, with construction of mine maps. Tunneling and shaft location. (2)

Assaying. — Including the assay by the dry methods of Gold, Silver, Antimony, Mercury, Lead, Iron and Tin ores. Laboratory Work. Ricketts. (3)

Drawing.—General views of mining plant and detailed sketches. (2)

Projects.—In Geology and Mining. (1)

Gymnasium.

SECOND TERM.

Mining.—Underground transportation. Hoisting, drainage and pumping. Ventilation and lighting. Hygiene of mines. Mining law. (3) Mechanical preparation of ores. Coal washing. (2)

Drawing. — Designing of mining plant. (2)

Mechanics of Machinery. — Pumps, pumping-engines, blowing-engines, compressors and fans. (4)

Hydraulics.—Hydrostatics. Flow of water in pipes and channels. Hydraulic motors. (2)

Lectures on American and English Literature. (2)

Christian Evidences.—Lectures. (1)

Preparation of Thesis.

Gymnasium.

POST-GRADUATE YEAR.

FIRST TERM.

Metallurgy.—Of Copper, Lead, Silver, Gold, Platinum, Mercury, Zinc, etc. (5)

Blowpipe Analysis.—Practice. (1)

Chemistry. — Qualitative Analysis: Laboratory Work: Fresenius. (3) The following analyses are executed by the student:

1. Iron Wire (Fe)
2. Copper Ore (Cu)
3. Silver Coin (Au, Ag, Pb, Cu)
4. Zinc Ore (Zn). By both Volumetric and Gravimetric methods.
5. Bronze (Cu, Sn, Zn, Pb)
6. Spiegeleisen (Mn)
7. Lead Ore (PbS)

Chemical Philosophy.—Cooke. (3)

Drawing. — General views of metallurgical plant and detailed sketches. (2)

Graphical Statics.—Graphical analysis of roof-trusses and girders. (2)

SECOND TERM.

Metallurgy. — Metallurgical Processes. Furnaces. Refractory building materials. Combustion. Natural and artificial fuels. Metallurgy of Iron. (4)

Chemistry.—Fresenius' Quantitative Analysis. (4) The following analyses are executed by the student:

8. Ilmenite (TiO_2)
9. Iron Ore (complete analysis)
10. Limestone (complete analysis)
11. Coal (Volatile Matter, Fixed Carbon, Ash, H_2O, S, P)
12. Slag (Complete Analysis)
13. Pig Iron (Complete Analysis)
14. Carbon in Steel (Volumetric)
15. Nickel Ore (Ni, Co)
16. Gas Analysis.

Stoichiometry. (2)

Drawing.—Designing of furnaces and other metallurgical plant. (2)

Projects.—In Metallurgy. (1)

Astronomy.—Doolittle's Practical Astronomy, with observatory work. (2)

Preparation of Thesis.

THE COURSE IN PHYSICS AND ELECTRICAL ENGINEERING.

In the arrangement of the details of this new course, the object has been to provide for those, who seek to fit themselves as Electrical Engineers, a preliminary training as complete and broad as that given to the members of the other schools. The requirements for admission, the mathematical and English studies, the modern languages and other outside branches are the same as those in the other technical courses. To these have been added such portions of the Mechanical Engineering Course, with which this course is most closely allied, as are necessary to give

the student a general, but sufficiently accurate knowledge of machinery.

This preparation joined to the unusually full development of Physics — and especially of Electricity — will, it is thought, make a course sufficiently comprehensive and thorough for the proper training of candidates for this degree. The great success attending the large majority of the young men who have taken the one year's Course in Electricity, in their subsequent electrical work, warrants the belief that this broader and more extended course will attain its object.

The main feature of this new course is the prominence given to the subject of Physics. This extends through three years and while Electricity is specially developed, the other branches, Elementary Mechanics, Heat and Light are fully provided for. The opportunity is thus given to any one, who wishes to acquire a more extensive knowledge of Physics than the University curriculum has heretofore offered. The student is well drilled in the theory by means of lectures and recitations, which carefully cover the whole subject, and he is required to go over the ground himself in the best of all schools—the working laboratory. Enough of work on each topic is given him to render him familiar with his subject. Much prominence is given to work that brings out the resources of the student himself, such as the construction of instruments and original investigation. He is encouraged to this and a regular portion of his time is set apart for this object.

It will be seen from the preceding statement that this course offers two great advantages: the thorough and extensive training of those intending to take part in the great development of Electric Science in the industrial field now going on and the facilities offered to those who wish to take a four years' course specially devoted to the whole branch of Physics.

The degree of Electrical Engineer (E.E.) will be given to the graduates of this course.

FRESHMAN CLASS.

FIRST TERM.

See page 59.

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

Chemistry.—Lectures and Laboratory Practice. Douglass and Prescott's Qualitative Analysis. (2)

French.—Chardenal, Second Course. Reader (continued). (3) Or *German.*—Grammar and Reader (continued). (3)

Drawing.—Projection Drawing and Descriptive Geometry. Warren's Elementary Projection Drawing. (3)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)

Mechanics, Sound and Heat.—(Theory, lectures and recitations.) (3)

Mechanics.—(Physical Laboratory). Exact Measurements. Density. Elasticity. Tenacity. Hydrostatics. Specific Gravity. Atmospheric Pressure (with barometric leveling.) Gravitation. Moments of Inertia.

Sound.—Determination of velocities and wave lengths. Measurements of vibrations. Verifications of laws of vibrations of sounding bodies.

Heat.—Construction of Instruments. Thermometry. Expansion. Conduction. Radiation. (4)

Drawing.—Isometrical Drawing. Architectural Drawing. (2)

French.—Grammar. Reading. Or *German.*—Grammar. Reading. (2)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics. — Differential and Integral Calculus: Olney and Courtenay. (4)

Heat.—Continued. (Physical Laboratory.) Fusion and Vaporization. Calorimetry. Hygrometry. Elementary Thermodynamics. (3)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Dictation. (2) Or *German.* — Grammar Reading. Dictation. (2)

Mechanics. – Theory of motion, statics, energy, center of gravity, moment of inertia and general equations of motion. (4)

Steam Engine.—Holmes's Steam Engine. (3)

Essays and Declamations.

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Courtenay's Calculus and Wood's Analytical Mechanics. (2)

French.—Readings Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation Class in both languages optional throughout the year.

Light and Magnetism.—(Theory ; text-books and lectures.) (3)

Light.—(Physical Laboratory). Investigation of general Principles and Laws. Determination of Focal Lengths and Indices of Refraction. Testing and Adjustment of Optical Instruments. Spectroscopic Analysis. Photometry. Polarization. Diffraction.

Magnetism.—Fundamental Experiments. Verification of Laws of Magnets. Study and Mapping of Lines of Force. Determination of Moments of Magnets ; and of horizontal component and whole intensity of Earth's Magnetism in absolute units. Distribution of Magnetism. (3)

Meteorology.—Text-book and practice. Observations for several months as taken in the U. S. Signal Service stations, with all the usual corrections and reductions; construction of charts; mapping curves; reports, etc. (1)

Strength of Materials.—Elasticity and strength of wood, stone and metals. Theory of beams, columns and shafts. (4)

Boilers.—Wilson. Strength, construction and wear and tear of boilers. (1)

Literature and History. (1)

Gymnasium. (2)

SECOND TERM.

Electricity.—Theory; text-books and lectures. (3)

Static Electricity.—(Physical Laboratory). Investigation of Principles. Quantitative Laws. Measurements of Potential, Capacity, etc. Induction. Condensation. Analysis of Machines.

Voltaic Electricity.—Management and care of a large variety of batteries. Construction of Instruments. Determination of Constants. Electro-Magnetism. Induction. Electro-Dynamics. Electrical Measurements of Potential, Resistance and Current Strength. Electrolysis. Electroplating. Electrotyping. Thermo-Electricity. Secondary Batteries. Relation of Electrical Currents to Heat and Mechanical Work. (5)

French.—Readings. Compositions. Lectures on French Literature. (2) Or *German.* — Readings. Compositions. Lectures on German Literature. (2)

Machine Design.—Calculations for a High Speed Steam Engine. Proportioning of such machine parts as come under the head of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers and connecting rods. (5)

Essays and Original Orations.

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Dynamic Machines.—Theory, text-book and lectures. (2) (Physical Laboratory). Practical running and care of dynamos and motors. Measurements of magnetic field, potential, resistance and heating. Visits to manufactories and working systems. (2)

Electric Lighting.—Lectures. (2) (Physical Laboratory). Study of different systems. Calculations and arrangement of plant. Wiring. Insulation. Photometric tests of different arc and incandescent lamps. Determination of heat units given off by various incandescent lamps; their resistance (hot and cold). Energy consumed in lamps and conductors. Spectroscopic tests of purity of carbons. (3)

Machine Design.—Proportioning of Machine Parts (continued). (2)

Astronomy.—Loomis' Treatise, with Lectures. (3)

Graphical Statics of Mechanism.—Herrmann-Smith. (2)

Scientific Readings.

Gymnasium.

SECOND TERM.

Telegraphs and Telephone.—Investigation of different systems. Arrangement of lines and stations. Test of lines for conductivity, insulation, location of faults, etc. (2)

Application of Electricity to Railways.—Theory of the two systems, with inspection of electric railways. (1)

Measurement of Power.—Indicating of Steam Engines; dynamometer experiments. (1)

Dynamic Machines.—(Physical Laboratory). Tests of Efficiency in Generators and Motors, etc. (1)

Physics.—Original Investigation. (5)

English Literature.—Lectures on English and American Literature. (2)

Christian Evidences. (1)

Preparation of Thesis.—(With laboratory work).

Gymnasium.

THE COURSE IN CHEMISTRY.

This course of study is designed to prepare students for the profession of the Chemist, in connection with metallurgical establishments, sugar refineries, gas works, superphosphate works, electrical machinery manufactories, mining companies, etc., and the general consulting and analytical work of the Professional Chemist. It is also well adapted for the preparation of teachers of chemistry and as a preliminary course to the study of medicine. It is eminently practical, the student's time being largely occupied by practical work in the large, well equipped and well ventilated chemical laboratories, which were completed in 1885 and constitute the best constructed building for this purpose in this country. The museum of Chemistry contains large collections of specimens, for illustrating the lectures on theoretical and applied Chemistry.

THEORETICAL CHEMISTRY.—Instruction in this subject begins with lectures four times a week, in the first term of the Freshman year; these lectures are fully illustrated by experiments, colored diagrams, working drawings and lantern pictures and specimens from the museum. They include a general introduction to Theoretical Chemistry and a description of the non-metallic and metallic elements and their compounds, the general subject of inorganic chemistry. The students are required to take notes of the lectures, and to pass a written examination at the end of the term.

In the second term of this year Stoichiometry and chemical problems and reactions are taught by recitations twice each week.

The study of Theoretical Chemistry is continued throughout the Sophomore year, by recitations three times a week from Cooke's Chemical Philosophy and is concluded in the first term of Junior, by a course of lectures and recitations on Theoretical Organic Chemistry, four times a week. These lectures are illustrated by experiments and by specimens from the museum of Chemistry.

Written examinations are held at the close of each of the above courses.

Analytical Chemistry. — Qualitative Analysis is taught in the second term of the Freshman year, by lectures, recitations and practical work in the Qualitative Laboratory, twelve hours of practical work per week being required. This laboratory is a large, well ventilated and well lighted room, and supplied with convenient working tables, vacuum filtration, hoods for noxious vapors, steam baths, gas and washing appliances and a commodious room for hydrosulphuric acid. Distilled water is delivered by faucet in this room and the other large laboratories. At the close of the term a practical examination is held in this subject.

After completing this course, Quantitative Analysis is pursued throughout the Sophomore and the first term of the Junior years. This subject is taught by lectures, recitations and practical work in the Quantitative Laboratory, which is equipped similarly to the Qualitative Laboratory, but is supplied in addition with apparatus for drying precipitates and residues, rooms for the chemical balances, for combustions, and for a reference library.

Twelve hours per week are required during the first term of the Sophomore year and fifteen hours during the second term of that year and the first term of the Junior year.

The course consists in Gravimetric and Volumetric Analyses, as applied to the substances given in the lists farther on, accuracy being required in the determination of each constituent.

At the close of each term, written examinations are held upon the theory and practice of Quantitative Analysis.

Gas Analysis is taught by lectures and laboratory practice in the Gas Laboratory. This laboratory is supplied with full and complete apparatus for Gas Analysis, according to Bunsen's processes, as well as apparatus for some of the more rapid methods. Mixtures of gases are required to be analyzed by the students, within certain limits of error,

and a written examination, on the theory and practice, is held at the close of the course.

ASSAYING.—The Assaying of ores by furnace assay, together with gold and silver bullion analysis, by processes practiced in the United States Mint, is taught by lectures and practical work in the first term of the Junior year, nine hours of practical work per week being required. The course includes the assaying of ores of lead, tin, antimony, gold, silver and iron, coal, and gold and silver bullion.

The Assaying Laboratory is supplied with large working tables, twenty-nine crucible and two iron furnaces, and eight muffle furnaces, with adjoining rooms for balances, and gold and silver bullion analysis.

A certain accuracy of results and a written examination as regards the theory and practice are required.

ORGANIC CHEMISTRY.—The practical work in this subject is performed in the second term of the Junior and first term of the Senior years, fifteen hours during the former and twelve hours during the latter term being required, with conferences and recitations each week. The laboratory for this work is equipped similarly to the Quantitative Laboratory, in addition being supplied with steam heat, cold water and air blast upon the working tables, and a full supply of apparatus for the various determinations and experiments, including combustion furnaces, furnaces for heating sealed tubes, mercury pump, Hoffman's, Dumas' and Meyers' apparatus for vapor densities, nitrometers, chemical balances, etc.

The course consists of determinations of specific gravities, melting points, boiling points, vapor densities, chlorine, bromine, iodine and sulphur of organic substances.

Combustion analysis, nitrogen determination, fractional distillation, and the preparation of several pure organic compounds and their analysis are included.

INDUSTRIAL CHEMISTRY. — A course of lectures is delivered upon this subject in the second term of the Senior year, illustrated by experiments, diagrams, lantern pictures

and specimens from the museum of Chemistry. The working laboratory for this subject contains an apparatus for making illuminating gas, an alcohol still, worm and double and a complete working model of a sugar refinery, including filters, vacuum pan and centrifugal. In connection with this laboratory is a room containing a photometer and apparatus for determining the sulphur, ammonia and specific gravity of illuminating gas; also a laboratory for the testing of alcoholic liquors, sugar, molasses, bone black, soap, petroleum, paints, dyes, superphosphates and other commercial products, with the necessary technical apparatus. The students make practical experiments in this direction, and, with an instructor, visit various industrial establishments in this neighborhood and in and around New York City.

Toxicology.— A course of lectures on this subject is given in the first term of the Junior year, illustrated by experiments and by the large collection of specimens of poisons from the museum of chemistry. This is supplemented by a short course of laboratory work on some of the common poisons.

Sanitary Chemistry. — During the second term of the Senior year, attention is given to the qualitative and quantitative examination of air, water, food, disinfectants, and other subjects connected with this branch of the science. Special apparatus is provided for this work, as recommended by the best authorities on the subject.

Photographic Chemistry. — Well equipped Photographic Laboratory and dark rooms are provided, in which the students of the chemical course receive practical instruction.

Physiological Chemistry. — The examination of urine, blood, etc., receives a proper amount of attention.

The course also includes instruction in physics, mineralogy, blowpipe analysis, metallurgy and geology, which are of great value to the chemist.

In the last term of the Senior year, the student is required to prepare a Thesis on some subject, selected by the Professor of Chemistry, involving practical work in the laboratory in addition to the literary labor, each graduate thus making a contribution to the progress of the science, as a preliminary to the reception of his degree.

The graduate of this course receives the degree of Analytical Chemist. (A.C.)

Students, not candidates for a degree, are admitted for special courses in chemistry, of which they receive certificates.

The Laboratories are under the immediate charge of the Professor and Instructors of Chemistry and are open to the students from 8 o'clock, A.M., to 6 o'clock, P. M., including Saturdays. Students are at liberty to work in the Laboratories, beyond the required hours, as their time may permit. Students are charged for materials and apparatus consumed; with moderate care this expense need not exceed $50 per year.

FRESHMAN CLASS.

FIRST TERM.

See page 59.

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

Chemistry.—Lectures and Laboratory Practice. Douglass and Prescott's Qualitative Analysis. (4)

French.—Chardenal, Second Course. Reader (continued). (3) Or *German.*—Grammar and Reader (continued). (3)

Stoichiometry. (2)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Chemical Philosophy.—Cooke. (3)

Quantitative Analysis.—Fresenius' Quantitative Analysis. (4)

The following analyses are executed by the student:

1. Iron Wire (Fe)
2. Potassium Dichromate (Cr_2O_3)
3. Barium Chloride (Ba, Cl, H_2O)
4. Magnesium Sulphate (MgO, SO_3, H_2O)
5. Disodium Hydrogen Phosphate (P_2O_5)
6. Rochelle Salt (K_2O, Na_2O)
7. Volumetric Determination of Chlorine.
8. Acidimetry (HCl, H_2SO_4, HNO_3, $HC_2H_3O_2$)
9. Alkalimetry (KOH, NaOH, NH_4OH, Soda Ash, Pearl Ash)
10. Chlorimetry (Bleaching Powders)

Quantitative Analysis—Conference. (1)

Physics.—Mechanics, Heat and Electricity. Lectures. (5)

French.—Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

Physics.—Sound, Light and Meteorology. Lectures. (3)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Dictation. (2) Or *German.*—Grammar. Reading. Dictation. (2)

Quantitative Analysis.—Fresenius' Quantitative Analysis. (5)

The following analyses are executed by the student:

11. Copper Ore (Cu)
12. Zinc Ore (Zn). By both Gravimetric and Volumetric Methods.
13. Lead Ore (Pb, S)
14. Silver Coin (Au, Pb, Ag, Cu)

15. Spiegeleisen (Mn)
16. Copper Alloys. (Complete Analysis.)
17. Ilmenite (TiO_2)
18. Iron Ore (Complete Analysis)
19. Limestone (Complete Analysis)
20. Coal (Volatile Matter, Fixed Carbon, Ash, H_2O, S, P)
21. Slag (Complete Analysis)

Quantitative Analysis.—Conference. (1)

Blow-Pipe Analysis.—Lectures, with Practice. Plattner, Brush, or Nason and Chandler. (1)

Chemical Philosophy. (3)

Essays and Declamations. (1)

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Toxicology.—Lectures. (2)

Quantitative Analysis.—Fresenius' Quantitative Analysis. (5)

The following analyses are executed by the student:

22. Guano (NH_3, P_2O_5, H_2O)
23. Clay (Complete Analysis)
24. Manganese Ore (MnO_2)
25. Mineral Water (Complete Analysis)
26. Pig Iron (Complete Analysis)
27. Nickel Ore (Ni, Co)
28. Carbon in Steel (Volumetric)
29. Gas Analysis.

Quantitative Analysis.—Conference. (1)

Organic Chemistry.—Lectures and Recitations. (4)

Crystallography. — Lectures, with practical exercises in the determination of crystals. (2)

French.—Readings. Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation Class in both languages optional throughout the year.

Gymnasium. (2)

SECOND TERM.

Organic Chemistry.—Laboratory. (5)

Organic Chemistry.—Conference. (1)

Metallurgy.—Metallurgical Processes. Furnaces. Refractory Building Materials. Combustion. Natural and Artificial Fuels. Metallurgy of Iron. (4)

French.—Readings. Compositions. Lectures on French Literature. (2) Or *German.*—Readings. Compositions. Lectures on German Literature. (2)

Mineralogy.—Descriptive Mineralogy, with practical exercises in the determination of minerals. E. S. Dana. (3)

Essays and Original Orations. (1)

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Metallurgy.—Of Copper, Lead, Silver, Gold, Platinum, Mercury, Tin, Zinc, Nickel, Cobalt, Arsenic, Antimony and Bismuth. (5)

Assaying.—Including the Assay by the dry methods of Gold, Silver, Antimony, Lead, Iron and Tin ores, Coal, Gold and Silver Bullion and rich Lead. Ricketts. (3)

Organic Chemistry.—Laboratory. (4)

Organic Chemistry.—Conference. (1)

Geology.—Williams' Lithology, with practical exercises in determining rocks. (3)

Gymnasium.

SECOND TERM.

Industrial Chemistry.—Lectures and Laboratory. (4)

Agricultural Chemistry.—Lectures. (1)

Sanitary Chemistry.—Laboratory. (1)

Geology.—Historic and Dynamic Geology. Lectures. Geikie. (2)

Christian Evidences.—Lectures. (1)

Lectures on American and English Literature. (2)

Preparation of Thesis. (5)

Gymnasium.

THE COURSE IN ARCHITECTURE.

The studies in this course are closely allied with those in civil engineering, the higher surveying, railroad work, mineralogy, geology and astronomy being omitted, instead of which architectural drawing and designing is substituted as seen in the following program. Instruction is also given in the history and æsthetics of architecture, in methods of heating and ventilating, in boilers and hoisting machinery, and in house drainage and sewerage.

During the first and second years the student lays the foundation for his professional work by the study of Mathematics, Physics, Mechanics, Drawing, Surveying, English, and French or German. The course in drawing includes the use of water colors, freehand, projection and isometric drawing, and their application to the general plans for a small building. In surveying there is field practice in the use of instruments, and also map drawing, thus enabling the student to understand the application of the subject to landscape gardening, and to the location of buildings.

During the third and fourth years of the course the work is of a more professional character. The subject of construction familiarizes the student with brick, stone, cement and other materials, with foundations and masonry, with arches, piers and walls, and with the stone cutter's art. There is a full course in the theory and calculation of columns, beams and shafts, in the strength of materials and its application to roof trusses and bridges. Working drawings of arches, piers and roof trusses are made in detail. Plans and estimates are prepared for wooden, brick, stone and iron buildings, the work being done according to standard specifications. In connection with the course visits of inspection are made to the numerous engineering structures in the Lehigh Valley and vicinity.

The student who completes all the subjects of this course will receive the degree of Bachelor of Science in Architecture (B. S.).

FRESHMAN CLASS.

FIRST TERM.

See page 59.

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

Surveying.—Theory of Chain and Compass Surveying. Computation of Areas. Elements of Leveling. (1)

French.—Chardenal, Second Course. (Reader continued). (3) Or *German.*—Grammar and Reader (continued). (3)

Drawing.—Projection Drawing and Descriptive Geometry. Drawings and Sketches from measurements of Objects. (4)

English.—Exercises and Declamations. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)

Physics.—Mechanics, Heat, and Electricity. Lectures. (5)

French.—Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

Drawing.—Isometric Drawing and Sketching. Architectural Drawing. Plans for a simple cottage. (2)

Surveying.—Use of the Compass, Level and Transit. Surveys and Maps of Farms. Colored Topography. (2)

English.—Exercises and Declamations. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics.—Differential and Integral Calculus: Olney and Courtenay. (4)

Physics.—Sound, Light and Meteorology. Lectures. (3)

French. — Grammar. O'Connor: Choix de Contes Contemporains. Dictation. (2) Or *German.*—Grammar. Reading. Dictation. (2)

Mechanics. — Theory of motion, statics, energy, center of gravity, moment of inertia and general equations of motion. (4)

Surveying.—Profiles and Contour Maps. Hydrographic and City Surveying. Use of the Plane Table. Topographical Drawing and Sketching. (3)

Essays and Declamations.

Gymnasium.

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Courtenay's Calculus, and Wood's Analytical Mechanics. (2)

French. — Readings. Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation Class in both languages optional throughout the year.

Strength of Materials. - Elasticity and Strength of Wood, Stone, and Metals. Theory of Columns, Shafts and Beams. Reports on the Testing of Materials. (4)

Construction. — Materials of Construction. Masonry. Foundations. Construction of Roads and Pavements. (2)

Drawing.—Shades, Shadows and Linear Perspective. Sketches and Designs for Ornaments and Simple Details. (6)

Literature and History. (1)

Gymnasium. (2)

SECOND TERM.

French.—Readings. Compositions. Lectures on French Literature. (2) Or *German.* — Readings. Compositions. Lectures on German Literature. (2)

Roofs and Bridges.—Theory and Calculation of Strains in Roof and Bridge Trusses. Graphical Statics. (3)

Construction.—Stone cutting, with practical Drawings. (2)

Theory of Retaining Walls and Stone Arches. Designs for Piers and Stone Arches. (2)

Architecture.—Designs and Estimates for Brick and Stone Buildings. (5)

History.—The History of Architecture. (2)

Essays and Original Orations.

Gymnasium. (2)

SENIOR YEAR.

FIRST TERM.

Roofs and Bridges.—Cantilever, Suspension and Arch Bridges. Designs for Plate Girders and Riveted Roof Trusses. (6)

Mechanics of Machinery.—Pile Drivers, Cranes and Elevators. (2)

Boilers.—Strength, construction, and wear and tear of boilers. Wilson. (1)

Architecture.—Specifications and Estimates. Design for an Iron Building. (5)

Heating and Ventilation.—Systems of heating, lighting and ventilating buildings. (2)

Gymnasium.

SECOND TERM.

Hydraulics.—Efflux of Water from orifices, and flow in pipes and channels. Hydraulic Motors. (2)

Sanitary Engineering.—Collection, Purification and Distribution of Water. Systems of Water Supply. The combined and the separate System of Sewerage. Drainage and Sewerage of Buildings. (4)

Roofs and Bridges.—Design for a Pin-connected Roof Truss, with Working Drawings. (3)

Architecture.—Building Superintendence. The Æsthetics of Architecture. Original Plans, Estimates and Specifications. (4)

Lectures on English Literature. (2)

Christian Evidences.—Lectures. (1)

Preparation of Thesis.

Gymnasium.

PHYSICAL CULTURE.

The Gymnasium is open morning, afternoon and evening, in all, 45 hours a week. Exercise in it is required of all students who are fitted to take it. Class drill with the Instructor and individual exercise are prescribed.

GRADUATING THESES.

Every student will be required to present a thesis upon some topic connected with his special course, as a necessary portion of the exercises for his final examination for a diploma. These theses shall be accompanied by drawings and diagrams, when the subjects need such illustration. The originals will be kept by the University, as a part of the student's record, for future reference; but a copy may be retained by the student, and be published, permission being first obtained from the President.

DIPLOMAS AND CERTIFICATES.

The Diploma is given only to those who have passed all the examinations in a regular course and is signed by the President and Secretary of the Board of Trustees and by the Faculty of the University. For all the partial courses a certificate is given, signed by the President and the Secretary of the Faculty, and showing what the student has accomplished.

GRADUATE STUDENTS.

Graduate students wishing to remain a year or more and pursue a course of study as candidates for another Degree may do so with the sanction of the Faculty. Those wishing to take *special* courses of study will be afforded every facility for so doing.

POST GRADUATE DEGREES.

M. A.

The Faculty will recommend for the Degree of Master of Arts any Candidate, otherwise properly qualified, who, after taking at this University the Degree of Bachelor of Arts, shall pursue, for at least one year at this University, or two years elsewhere, a course of liberal study prescribed by the Faculty in at least two departments, pass a thorough examination in the same and present a satisfactory Thesis.

M. S.

The Faculty will recommend for the Degree of Master of Science any Candidate, otherwise properly qualified, who, after taking at this University the Degree of Bachelor of Science, or any Degree in the School of Technology, shall pursue, for at least one year at this University, or two years elsewhere, a course of study prescribed by the Faculty in at least two departments, pass a thorough examination in the same and present a satisfactory Thesis.

Ph. D.

The Faculty will recommend for the Degree of Doctor of Philosophy any Candidate, otherwise properly qualified, who, after taking at this University the Degree of Master of Arts or Master of Science, shall pursue, for at least one year at this University, or two years elsewhere, a course of advanced study prescribed by the Faculty, in at least two departments, pass a thorough examination in the presence of the Faculty in the same and present a satisfactory Thesis giving evidence of original investigation.

The Candidate shall have a good knowledge of Latin and either French or German.

The Theses presented by Candidates for Post Graduate Degrees shall be retained by the University.

Applicants for any of these degrees will be required to complete the prescribed work within the allotted time. Special action of the Faculty is required for any extension of time.

THE UNIVERSITY LIBRARY.

The Library building was erected by the Founder of the University in 1877, at a cost of One Hundred Thousand Dollars, as a memorial of his daughter, Mrs. Lucy Packer Linderman, and during the same year more than Twenty Thousand Dollars were contributed by her family and friends, as a memorial fund for the purchase of books. By the will of the Founder of the University a fund of $500,000 has been given for the permanent endowment of the library.

The building is semi-circular in plan, with a handsome façade in the Venetian style of architecture. It is constructed of Potsdam sandstone with granite ornamentation. In the interior, the center is occupied as a reading space, fifty by forty feet, from which radiate the book cases, extending from floor to ceiling; two galleries affording access to the upper cases. Shelf room is now provided for one hundred and sixty thousand volumes. The building is thoroughly fireproof, well lighted, and heated by steam.

Seventy-nine thousand volumes are now upon the shelves, including many extremely valuable works. The list of periodicals numbers about one hundred and twenty-five, embracing as far as possible all departments of knowledge.

The Library is conducted strictly for consultation, and is open to the use of the public; both of which conditions are in accord with the terms of the gift.

REGULATIONS OF THE LEHIGH UNIVERSITY LIBRARY.

I. The Library is open every day, except Sundays and Legal Holidays, from 8 A. M. until 10 P. M., and on Sundays for the students and others connected with the University from 1.30 P. M. until 9.30 P. M.

II. Admission is free to all persons over 16 years of age.

III. Readers are required to write their names and addresses in the Daily Register of the Library. They also write the name of the book desired upon a Library Card, with their signatures, and present the same to the Director's Clerk, who supplies the

book, retaining the card as a receipt. Before leaving the Library, readers return their books to the clerk, and receive their cards.

IV. The University Professors and Instructors, only, are allowed to take books from the Library Building.

V. No person is allowed to enter the alcoves, or remove any book from the shelves, without permission of the Director.

VI. Readers wishing to consult the more valuable illustrated works make special application for that purpose.

VII. In taking notes, pencils, and not pens and ink, are to be used.

VIII. Audible conversation and the use of tobacco are strictly forbidden in any part of the Library.

IX. Any person not conforming to these Regulations, will be denied the privilege of the Library.

X. Any person, who defaces, in any way, any book, magazine or paper, or the furniture, or any portion of the building, in addition to being deprived of the privileges of the Library, will be prosecuted according to law.

OBSERVATORY.

By the liberality of Robert H. Sayre, Esq., one of the Trustees of the University, an Astronomical Observatory was erected on the University grounds, and placed under the charge of the Professor of Mathematics and Astronomy.

In the dome of the Observatory is mounted an Equatorial Telescope, of six inches aperture, by Alvin Clark & Sons. The west wing contains a superior Sidereal Clock, by Wm. Bond & Sons; a Zenith Telescope, by Blunt, and a Field Transit, by Stackpole. There is also a Prismatic Sextant, by Pistor & Martins.

Students in Practical Astronomy receive instruction in the use of the instruments and in actual observation.

The grounds upon which the Observatory stands, consisting of seven acres of land adjoining the original grant, was

presented to the University by Charles Brodhead, Esq., of Bethlehem.

An advanced course in Astronomy and the higher Analysis has been established, requiring two years for its completion. It is adapted to the attainments of the graduates of this University, but is open to any one who may be prepared to pursue it.

This course embraces the following subjects:

First Year.—Spherical Astronomy. Theory of Instruments. Method of Least Squares. Numerical Calculus.

Second Year.—Celestial Mechanics. Interpolation and Quadrature. Computation of Orbits and Perturbations.

During the entire course the student will have ample opportunity to familiarize himself with the practical work of the Observatory and Computing Room.

THE PACKER MEMORIAL CHURCH,

is the recent and munificent gift of Mrs. Mary Packer Cummings, daughter of the Founder of the University. It is a large and magnificent Church, richly furnished and handsomely appointed in every particular. There is no more beautiful Church edifice in the State and it is one of the noblest in all the land.

THE UNIVERSITY MUSEUM.

In addition to the large collection illustrating all branches of Industrial Chemistry, the Museum includes collections in Metallurgy, Geology, Zoology, and Archæology.

The Metallurgical Cabinet already includes specimens illustrating the various processes for obtaining the more common metals.

The Zoological Cabinet includes the Werner collection of nearly all the types of American birds with their nests and eggs, and the Packer collection of recent shells.

The Geological Cabinet numbers over ten thousand specimens and includes the Palæontological, Mineralogical, Petrographic and Economic collections. The former contains good specimens of nearly all the common genera. The

Mineralogical division includes the Keim and Rœpper collections—the latter being especially complete and valuable from a crystallographic stand-point. The Petrographic division numbers several thousand specimens and besides including numerous varieties of nearly all the rocks of the globe, contains a duplicate set from the collection of the Second Geological Survey of this State. The Economic division was formed and donated by Dr. James P. Kimball, Director of the Mint, and formerly Professor of Economic Geology.

The Cummings Archæological Cabinet numbers three thousand specimens and includes Dr. Stubbs' Collection of Indian relics, weapons, and utensils.

THE CHEMICAL AND NATURAL HISTORY SOCIETY OF THE LEHIGH UNIVERSITY.

This Society was organized in the Fall of 1871, as "The Chemical Society," but was afterwards expanded, as its present title indicates, and admits, by election, students from all departments of the University.

The collections of Botanical and Zoological Specimens belonging to the Society are already important. During the past years persons have been sent to Texas and Brazil to collect specimens for these cabinets.

The Society has organized and maintained several courses of public scientific lectures.

Among the honorary members of the Society are more than one hundred of the most distinguished scientists in Europe and the United States.

THE ENGINEERING SOCIETY.

This society was organized in 1873, and admits, by election, students in the Junior and Senior Classes. Its meetings are held fortnightly. At these, papers relating to engineering subjects are read and discussed. It issues quarterly "The Journal of the Engineering Society," to which the members and others contribute.

THE MINING CLUB.

This was organized in 1883 and takes from the Junior, Senior and Post Senior Classes, those members of the Mining School who excel in their studies or in practical experience in the subjects of the course.

THE ELECTRICAL ENGINEERING SOCIETY

was organized in November, 1887, by students in the Advanced Course in Electricity. Its object is to supplement the regular work of the department by the study and discussion of electrical subjects.

THE AGORA

is a Literary Society which meets semi-monthly. Only students in the School of General Literature are eligible to membership.

THE ATHENÆUM.

is also a Literary Society, whose active membership is confined to the Sophomore Class. The meetings are held weekly.

THE CLASSICAL CLUB.

This organization was formed in the Spring of 1889 by students in the Classical and Latin-Scientific Courses. At its monthly meetings, papers upon philological, historical and archæological subjects are read by students belonging to the upper classes and are then discussed and criticised. Thus independent work is encouraged and correct methods of investigation are acquired. Reports upon new discoveries and reviews of recent books vary the proceedings and keep the members informed in regard to the advances of philological science.

THE UNIVERSITY GUILD

is a Society for the promotion of the religious, mental, moral and social life of the students of the University. The Right Reverend, the Assistant Bishop of Central Pennsylvania, is Honorary President and the Chaplain of the University, Honorary Vice-President. Its meetings are held fortnightly at the residence of the Chaplain. It is an active and flourishing society of important and growing influence.

THE NATURAL SCIENCE CLUB OF THE LEHIGH UNIVERSITY.

The object of this organization is systematic study, in connection with field work, in Natural History and its associated subjects. Its members are engaged in making a survey, both botanical and mineralogical, of the region within a radius of five miles from the University and propose to collect an herbarium and mineralogical cabinet which shall contain specimens of all the plants and minerals within this district.

FOUNDER'S DAY.

On the second Thursday of October of each year, Commemorative Exercises are held in honor of the Founder of the University.

Thursday, October 10, 1889, the Eleventh Founder's Day was celebrated. An address was delivered by Professor Henry Coppée, LL.D.

WASHINGTON'S BIRTHDAY.

This day is observed as a holiday.

On Thursday, February 22, 1889, exercises were held in the Chapel, and orations were delivered by Messrs. Fisher, Foering, Miller, Neumeyer, Perkins and Prindle.

UNIVERSITY SERMON.

This sermon is preached on the Sunday before University Day.

The Rev. Eliphalet Nott Potter, D.D., LL.D., President of Hobart College, was the preacher on Sunday, June 16, 1889, in the Memorial Church.

THESES.

Theses on the following subjects were prepared by the graduating class of 1889.

"Steam Heating of Railroad Cars."

PEARCE ATKINSON.

"Determination of the Power consumed by a Drill Press."

GUSTAV AYRES.

"Description and Discussion of the Cabin John Stone Arch, near Washington, D. C."

RALPH PUTNAM BARNARD.

"A Discussion of the Porter Governor."

ALBERT HARLAN BATES.

"Menander."

SAMUEL ERWIN BERGER.

"Experiments on the Rapid Separation of Nickel and Cobalt."

JOSEPH LEANDER BUDD.

"Heinrich Heine."

EDGAR CAMPBELL.

"Investigation of the Reaction between Potassium Permanganate and Cobaltous Oxide."

FRANCIS JOSEPH CARMAN.

"Design of an American Passenger Locomotive."

HERBERT MACKENZIE CARSON.

"Review of the Canal Bridge on Main Street in Old South Bethlehem."

HOLDEN WILLIAM CHESTER.

"A Comparison of Interlocking and Railroad Signaling Appliances."

JUSTICE COX CORNELIUS.

"Examination of the 'Standard' Westinghouse Automatic Engine."

WILLIAM ALBERT CORNELIUS.

"Design for an Iron Highway Bridge between Bethlehem and South Bethlehem, Pa."

CHARLES HERBERT DEANS.

"The Code Napoleon."

CHARLES ESTELL DICKERSON, JR.

"Algebraic and Graphical Methods for Determining Moments of Inertia of Plane Figures."

EMIL DIEBITSCH.

"The Chemical Investigation of Wine."

ERNEST HIPOLITE DU VIVIER.

"The Internal Struggle in Rome between the Plebeian and Patrician Orders."

WILLIAM DOLLOWAY FARWELL.

"The History of the Chemical Theory."

MILTON HENRY FEHNEL, B.S.

"Richard Wagner."

ARTHUR HUGH FRAZIER.

"Design for a High Trestle for the Raritan Valley Railroad."

LOUIS PREVOST GASTON, B.S.

"Discussion of Experiments on the Efficiency of the Six-inch Eureka Turbine in the Hydraulic Laboratory of the Lehigh University."

LIGHTNER HENDERSON.

"Design for an Iron Highway Bridge betwen Bethlehem and South Bethlehem, Pa."

CLARENCE WALTER HUDSON.

"The Naphtha Engine."

ARCHIBALD JOHNSTON.
JOHN MARTIN SHARPLESS KERLIN.

"Review of the Process of Manufacture of Leather by means of Oak and Hemlock Barks."

JOHN STOWER KELLOGG, JR.

"Greek Tragedy."

SYLVANUS ELMER LAMBERT.

"Review of the Bridges on the Lehigh & Lackawanna Railroad between Bethlehem and Bath."

JOHN JOSEPH LINCOLN.

"Design for an Ice Machine and Refrigerator."

JOHN LOCKETT.

"Experiments on the Rapid Estimation of Magnesium as Pyrophosphate."

ARTHUR LONG.

h

"Design for a Wrought Iron Foot Bridge over the North Pennsylvania Railroad at New Street, South Bethlehem, Penna."

JOHN JOSEPH MARTIN.

"Comparative Delicacy of Several Tests for Iodine."

CHARLES HENRY MILLER.

"The Economic Value of Forced Draughts."

CHARLES WILLIAMS MOFFETT.

"The Archer Gas Process."

WILLIAM ELLIS MORRIS.

"Design for an Atlantic Passenger Steamer."

JOHN THOMAS MORROW.

"Deduction of a Formula for the Secular Variation of the Magnetic Declination at South Bethlehem, Pa."

ALBERT DANIEL OBERLY.

"A Comparison of Rapid Methods for determining Silicon, Iron, Manganese and Phosphorus in Ores; also, a plan for a Chemical Laboratory adapted to analytical work at an ore mine."

JOSEPH MICHAEL O'MALLEY.

"The Westinghouse Air Brake."

ROBERT HENRY EDDY PORTER.

"A Test of the Steam Plant at the Electric Light Station, Fort Wayne, Ind."

ABRAHAM LINCOLN ROGERS.

"Design for a Rotary Valve Gear."

CHARLES WILLIAM SCHWARTZ, JR.

"A Review of the Lehigh Valley Railroad from Mauch Chunk to Penn Haven.

ALFRED WALTON STOCKETT.

"Plan for a Horse Railway between Bethlehem and South Bethlehem."

LESTER CLARK TAYLOR.

"Review of the Water-Supply System at Clyde, N. Y."

AUGUSTUS THOMPSON THROOP.

"Design for a Timber-Mortising Machine."

CHARLES PRENTICE TURNER.

"The Examination of Commercial Fixed Oils and Fats."

WALTER EARLE WEIMER.

"Stresses in Bridge Trusses due to Initial Tension in Counters."

EDWARD AUSTIN WRIGHT.

"A Review of the Pratt Truss Bridge on the Pennsylvania Railroad at Phillipsburg, N. J."

JOSEPH BODINE WRIGHT.

THESES FOR THE DEGREE OF E.M.

"The Eighth Street Cable Railway Tunnel at Kansas City, Mo."

RICHARD SINGMASTER BREINIG.

"Economic Questions in Anthracite Coal Preparation."

OTTO CORNELIUS BURKHARDT.

"A Review of Archer's Patent Process for the Production of Fuel Gas."

ALFRED ELI LEWIS, JR., B.S.

"Shaft-sinking in Water-bearing Strata, with a Review of the Poetsch-Sooy-Smith System."

WYNDHAM HARVEY STOKES, B.S.

"Construction of a Blast Furnace."

WADE HAMPTON WOODS, B.S.

THESES FOR THE DEGREE OF M.A.

"The Roman Law, and its Influence on the English."

FRANCIS JOSEPH CRILLY, B.A.

"Early English Parliament."

JOHN DANIEL HOFFMAN, B.A.

UNIVERSITY DAY.

This day is the last of the academic year and falls in 1890 on the third Thursday in June. On this day orations are delivered by members of the Graduating Class, and Degrees are conferred.

EXERCISES ON JUNE 20, 1889.

Reading of Scripture and Prayer by the Rt. Rev. M. A. de Wolfe Howe, D.D., LL.D., Bishop of the Diocese.

Salutatory Oration.—"Copernicus."

SAMUEL ERWIN BERGER.

Oration.—"Immigration."

CHARLES PRENTICE TURNER.

Oration.—"Savonarola."

FREDERICK LOUIS GRAMMER.

Oration.—"The Inter-oceanic Canal."

EMIL DIEBITSCH.

Oration.—"Rienzi."

WILLIAM DOLLOWAY FARWELL.

Valedictory Oration.

JOHN LOCKETT.

Award of the Wilbur Scholarship to

WALTON FORSTALL,

of Chicago, Ill., first in rank in the Sophomore Class.

The Wilbur Prizes were awarded as follows:

Freshman Class, Mathematics,

CHARLES MERRITT CASE,
CHARLES OAKS WOODS.

Freshman Class, French.

JOHN YOUNG BASSELL, JR.

Freshman Class, German.

ALFRED EMORY LISTER.

Freshman Class, Free Hand Drawing.

ROBERT JONES SNYDER.

Prizes for Machine Drawing, offered by Mr. Flather, Instructor in Mechanical Engineering, were awarded to

ALFRED EMORY LISTER,
ROBERT JONES SNYDER,

of the Freshman Class.

The following degrees were conferred :

M. A.

FRANCIS JOSEPH CRILLY, B. A.,
JOHN DANIEL HOFFMAN, B. A.

E. M.

RICHARD SINGMASTER BREINIG,
OTTO CORNELIUS BURKHARDT,
ALFRED ELI LEWIS, JR., B. S.,
WYNDHAM HARVEY STOKES, B. S.,
WADE HAMPTON WOODS, B. S., B. M.

B. A.

SAMUEL ERWIN BERGER,
EDGAR CAMPBELL,
WILLIAM DOLLOWAY FARWELL,
ARTHUR HUGH FRAZIER,
SYLVANUS ELMER LAMBERT.

B. S.

CHARLES ESTELL DICKERSON, JR.

C. E.

RALPH PUTNAM BARNARD,
HOLDEN WILLIAM CHESTER,
JUSTICE COX CORNELIUS,
CHARLES HERBERT DEANS,
EMIL DIEBITSCH,
LOUIS PREVOST GASTON, B. S.,
LIGHTNER HENDERSON,
CLARENCE WALTER HUDSON,
JOHN JOSEPH LINCOLN,
JOHN JOSEPH MARTIN,
ALBERT DANIEL OBERLY,
ALFRED WALTON STOCKETT,

LESTER CLARK TAYLOR,
AUGUSTUS THOMPSON THROOP,
EDWARD AUSTIN WRIGHT,
JOSEPH BODINE WRIGHT.

M. E.

PEARCE ATKINSON,
GUSTAV AYRES,
ALBERT HARLAN BATES,
HERBERT MACKENZIE CARSON,
WILLIAM ALBERT CORNELIUS,
ARCHIBALD JOHNSTON,
JOHN MARTIN SHARPLESS KERLIN,
JOHN LOCKETT,

CHARLES WILLIAMS MOFFET,
JOHN THOMAS MORROW,
ROBERT HENRY EDDY PORTER,
ABRAHAM LINCOLM ROGERS,
CHARLES WILLIAM SCHWARTZ, JR.,
CHARLES PRENTICE TURNER.

B. S.

(In Mining and Metallurgy.)

JAMES WILLOUGHBY ANDERSON,
RICHARD SINGMASTER BREINIG,
OTTO CORNELIUS BURKHARDT,
CHARLES WILLIAM CORBIN,
JOHN WEBSTER DOUGHERTY,
RALPH MARSHALL DRAVO,
FREDERICK LOUIS GRAMMER,
GEORGE WENTZ HARRIS,
CONRAD EGBERT HESSE,
RICHARD HENRY MORRIS, JR.,
ARNOLD KARTHAUS REESE,
ARTHUR MOULT SMYTH,
CLARENCE WALKER,
HARRY RUSH WOODALL.

A. C.

JOSEPH LEANDER BUDD,
FRANCIS JOSEPH CARMAN,
ERNEST HIPOLITE DU VIVIER,
MILTON HENRY FEHNEL, B. S.,
JOHN STOWER KELLOGG, JR.,
ARTHUR LONG,
CHARLES HENRY MILLER,
WILLIAM ELLIS MORRIS,
JOSEPH MICHAEL O'MALLEY,
WALTER EARLE WEIMER,

The Benediction was then pronounced by the Bishop.

THE WILBUR SCHOLARSHIP.

This Scholarship was founded in 1872 by E. P. Wilbur, Esq., of South Bethlehem, and is the sum of $200 awarded annually to the student in the Sophomore Class having the best record.

THE ALUMNI SCHOLARSHIP.

The Alumni Association of the University has established a Scholarship of the value of $250 per annum, subject to the following conditions:

1. That the Scholarship shall only be awarded to a student really in need of it.

2. That the Scholarship shall not apply to the first year of any student's course; he must without this aid have gone through one year, and must be prepared to start the second year free from all conditions.

3. That the Scholarship shall not be continued to a student who shall at any time during his course carry any condition over eight weeks beyond the date of the examination in which he failed.

Subject only to the above conditions the disposal of the fund shall until otherwise directed be in the hands of the President of the University.

THE HENRY S. HAINES MEMORIAL SCHOLARSHIP.

Mrs. Henry S. Haines, of Savannah, Ga., has established a scholarship of the annual value of $200 which is to be devoted to the support at the Lehigh University, throughout his scholastic career, of one student in the School of Mechanical Engineering; the selection to be made by Mrs. Haines herself, during her life-time.

WILBUR PRIZE.

By the generosity of E. P. Wilbur, Esq., a fund has been established yielding an annual income of $100, for distribution in prizes as the Faculty shall determine.

ALUMNI PRIZES FOR ORATORY.

The "Alumni Association of the Lehigh University" has established an Annual Sum of Fifty Dollars, to be distributed as prizes for excellence in Oratory, subject to the following

REGULATIONS.

1. The Contest shall be held on the 22d day of February, or on the day designated by the University to commemorate the birthday of Washington.

2. There shall be a first prize of $25, a second of $15, and a third of $10.

3. To entitle one to be a competitor he must be a member of the Junior Class, taking a regular course.

4. Subjects for the oration shall be announced at the beginning of the first Term of every year, and upon one of these each competitor shall write an oration not to exceed eight minutes in delivery.

5. Each oration shall bear upon its first page a fictitious name or motto, and shall be accompanied by a sealed envelope, which shall be superscribed with the same name or motto, and an address by which it may be reclaimed. The envelope shall contain the real name and address of the

writer, with the declaration that the oration is his own original work. The examiner, having adopted a standard of excellence, may reject any or all of the orations presented which do not attain to this standard; of such as do —should they be sufficient in number—the best six shall be chosen, and their envelopes opened. The others shall be returned to the address given with their envelopes unopened.

6. The Executive Committee of the Alumni Association, or a committee of not fewer than three to be appointed by them, shall hear the competitors, whose orations shall have been approved, and the awards shall be made by a majority of these Judges.

7. In awarding the prizes the judges shall consider both the literary merits and the delivery of each oration.

8. These rules are subject to amendment by the Faculty.

At the last contest, the First Prize was awarded to

HOWARD AUGUSTUS FOERING,

the Second, to

ROBERT ENGLER NEUMEYER,

and the Third, to

EDWIN JAY PRINDLE.

The next contest will take place February 22, 1890.

ENTRANCE EXAMINATION PAPERS.

Used at the Examination in 1889.

[Requests for other examination papers than those herein printed can not be granted.]

I.—ENGLISH GRAMMAR.

1. Give the principal parts of the verbs *shrink*, *kneel*, *let*, *beat*, *chide*, *fly*, *shake*, *thrive*, *swim*.

1. How is the plural of compound nouns formed? Give two nouns that have no plural form; two that have no singular form.

3. Name and define the different classes of adjective pronouns.

4. Write four sentences: the first is to contain *that* as an adjective; the second, *that* as a relative pronoun; the third, *that* as an adjective pronoun; the fourth, *that* as a conjunction.

5. How are the person and number of the verb determined when the subject is compound?

6. Correct or justify the following sentences:

a. Neither Anna nor Ernest have permission to go.

b. Everybody are very kind to her.

c. Let any pupil put this in diagram if they can.

d. Was it thou or the wind who shut the door?

e. All pupils which have recited may be dismissed.

f. It was me that did it.

g. I bade him to take heed lest he makes life a failure?

h. The number of bounty jumpers are enormous.

i. How is the gender and number of the relative known?

j. I can not tell who I saw there.

7. Analyze this sentence fully, naming and classifying all clauses. Name five adjective phrases found in it. Parse words in italics.

"The storm had *long* given place to a calm the most *profound*, and the evening *was* pretty far *advanced*, *when* the three friends, *or*, *as* one might say, *both* in a civil *and* religious sense, and with proper deference and regard to the holy state of matrimony, the two friends (Mr. and Mrs. Brodie *counting as* no more *than* one) were startled by the noise of loud and angry threatenings *below* stairs, *which* presently attained *so* high a pitch, and were conveyed besides by language so towering and ferocious *that* it could hardly have been surpassed, *if there* had actually been a Saracen's head then present in the establishment, supported on the shoulders and surmounting the trunk of a real, live, furious, and most unappeasable Saracen."

II.—GEOGRAPHY.

An outline map of the Eastern half of the United States was furnished to each applicant and he was required to draw the boundaries of States, place capitals and chief cities, principal rivers and mountain systems.

III.—UNITED STATES HISTORY.

1. When did New Jersey become a Royal?—when an entirely separate Colony?—and when were the first settlements made?

2. What three Acts were passed by Parliament in 1767? What was their effect on the Colonies? What was done for the next six years? Who were the Whigs, and who the Tories?

3. What powers were given to Washington by Congress before its abandoning Philadelphia? When did Washington take Trenton, and when did the battle of Princeton take place?

4. Who were about 1786 the leading men of the country? and what did they propose, in order to make a Constitution in place of the Articles of Confederation? When was this Constitution agreed to, and when had it to go into force?

5. What were the leading events of Adams's Administration? Has Adams served one or two terms?

6. What were the four parties at the Presidential election of 1860? and who were their candidates?

7. What were the positions of the Union army in the West in the beginning of 1863? What were the different plans of Gen. Grant about Vicksburg? Who commanded in Vicksburg? and when was Vicksburg taken?

8. How is the Senate composed? How are the Senators chosen, and how long do they serve? Who presides over the Senate? When does the Chief Justice preside?

9. Name at least four of the powers that are denied to the States.

10. How is a vacancy by the removal, death, resignation or inability of the Vice-President to be provided for?

IV.—ARITHMETIC.

1. (*a*) Write the numbers: ten billions and ten; one million and one millionth; eleven thousand eleven hundred and eleven.

(*b*) What is an odd number? A prime number? A factor? A dividend? A quotient?

(*c*) Give rules for position of decimal point in multiplication and division.

2. How many square inches in a square foot? How many inches in a metre? In a link? Links in a chain? Square rods in an acre?

3. Bethlehem is 1° 40′ 3″ East of Washington. What is the time at Bethlehem when it is 2 P.M. at Washington?

4. 1 mile 10 rods 3 feet 2 inches equal how many kilometres?

5. Find interest, discount, and bank discount on $1755.16 for 60 days at 5 per cent.

6. At what time between 6 and 7 o'clock will the hour and minute hand of a clock be together?

V.—GEOMETRY.

1. (*a*) Define a right line; a plane; a plane angle; a right angle.

(*b*) Define the various kinds of triangles; also quadrilaterals.

(*c*) Define a circle; a chord; a secant; a tangent; a sector; a segment.

2. (*a*) Define a diedral angle; plane angle of a diedral angle; polyedral angle; convex polyedral angle.

(*b*) Define similar polygons; regular polygons; geometrical locus. State the conditions under which a single figure is said to be symmetrical.

(*c*) Define a variable; limit of a variable. Give example of limit of a variable. Define maximum quantity; minimum quantity. Give example of a maximum quantity.

3. The three medial lines of a triangle meet in a point.

4. If the sum of two opposite sides of a quadrilateral is equal to the sum of the other two sides, the quadrilateral may be circumscribed about a circle.

5. If through any fixed point in the plane of a circle a chord is drawn, the product of the segments is the same whatever the direction of the chord (take the point outside the circle).

6. If similar polygons be constructed upon the sides of a right triangle as homologous sides, the one on the hypothenuse will be equivalent to the sum of those on the other two sides.

7. Show how to compute the ratio of the *diameter* of a circle to the *circumference* approximately.

8. Of all plane figures having the same area the circle has the minimum perimeter.

9. A common perpendicular can be drawn to any two lines not in the same plane, and but one.

10. The sum of all the face angles of any polyedral angle is less than four right angles.

VI.—ALGEBRA.

1. (*a*) Give definitions of quantity; number; commensurable quantities; theorem; axiom; postulate.

(*b*) Give definitions of involution; evolution; equation; degree of an equation.

2. (*a*) What is the greatest common divisor of two or more quantities? What is elimination? Explain the three methods of elimination.

(*b*) Explain how fractions are added and multiplied. Explain how radicals are added and multiplied.

3. Give formulæ for *n*th term and sum of *n* terms of an arithmetical progression. What is the form to which every equation of the second degree may be reduced?

4. Find the greatest common divisor of the following:

$$\left\{\begin{matrix} 4x^3 - 6x^2 - 4x + 3 \\ 2x^3 + x^2 + x - 1 \end{matrix}\right\}; \qquad \left\{\begin{matrix} 6x^2 - 30x - 36 \\ 9x^2 + 27x + 18 \\ 12x^2 - 12 \end{matrix}\right\}.$$

5. Solve the following equations:

$$(a + x)(b + x) = (m + x)(n + x);$$

$$\frac{x-2}{5} + \frac{.301}{.5} = .001x + .6 - \frac{x-2}{.05};$$

$$\left\{\begin{matrix} \frac{1}{x} + \frac{1}{y} = \frac{1}{a}; \\ \frac{1}{y} + \frac{1}{z} = \frac{1}{b}; \\ \frac{1}{z} + \frac{1}{x} = \frac{1}{c}. \end{matrix}\right\}$$

6. Reduce the following expressions to simplest forms having rational denominators:

$$\left(\frac{1+x}{1+\sqrt{1+x}} - \frac{1-x}{1-\sqrt{1+x}}\right); \left(\frac{1+\sqrt{-1}}{1-\sqrt{-1}} - \frac{1-\sqrt{-1}}{1+\sqrt{-1}}\right);$$

$$\left(\frac{a+\sqrt{-b}}{a^{-\frac{3}{2}} b^{\frac{1}{2}}} \times \frac{a-\sqrt{-b}}{a^{-\frac{1}{2}} b^{\frac{1}{2}}}\right)$$

7. A sum of money at interest amounted to \$550 in ten months, and to \$560 in 12 months. What was the sum, and the rate per cent.?

8. Solve the following equations:

$$\sqrt{x} - \sqrt{x-3} = \frac{2}{\sqrt{x}};$$ find value of x.

$$\frac{1}{a+b+x} = \frac{1}{a} + \frac{1}{b} + \frac{1}{x};$$ find value of x.

$$\left\{\begin{matrix} 2x^2 - 2xy - y^2 = 3; \\ x^2 + 3xy + y^2 = 11; \end{matrix}\right\}$$ find value of x and y.

VII.—PHYSICS.

NOTE.—*The examination in Physics must be passed in June or September of that year in which the candidate proposes to enter the University.*

1. Define (*a*) Absolute Unit of Force.
   (*b*) Gravitation.
   (*c*) Difference of Potential.
   (*d*) Luminous Body.
   (*e*) Mechanical Equivalent of Heat.

2. What is Mariotte's Law?

3. How much water will flow from an orifice 2 inches in diameter in an hour, if the surface is kept 49 feet above the center of the orifice, and what will be the velocity of the water as it issues?

4. A body falls 1000 meters in vacuo.
   (*a*) What is the time of its fall?
   (*b*) What is its velocity at the end?

5. What are the Elements of a Musical Sound? Name and define them.

6. An observer supposes himself in the range of a distant cannon, the report of which he hears 19 seconds after seeing the flash; how soon may he apprehend danger from the ball, supposing it to fly at the rate of a mile in 8 seconds, the temperature of the air being 84 degrees Fahrenheit?

7. How can the Latent Heat of Water be determined experimentally?

8. Five pounds of ice at 32 degrees Fahrenheit are mixed with 7 pounds of water at 200 degrees Fahrenheit. What will be the temperature of the mixture?

9. How much ice at 32 degrees Fahrenheit is required to cool 10 pounds of mercury at 300 degrees Fahrenheit to the freezing point of water, the specific heat of mercury being 0.0333?

10. What is Double Refraction?

11. If a battery of 6 cells, each with an E.M.F. of 1.4 volts and an internal resistance of 5 ohms, be arranged with an external resistance of 80 ohms, first in parallel and secondly

in series; what would be the strength of current in each case?

12. Describe the Electrophorus.

13. Describe the Electric Lamps.

(*a*) Arc.

(*b*) Incandescent.

14. What must be the potential of a battery, which with a total resistance of 4.6 ohms gives a current of 0.036 amperes?

VIII.—LATIN.

I. Grammar.

[In writing Latin words of more than two syllables, mark the quantity of the penult.]

1. Give the genitive and accusative singular of *portus*, *animus*, *pelagus;* the genitive and dative plural of *dea*, *vis*, *caput*, *mare;* the dative singular of *aliquis*, *cornu;* the nominative singular of *nivem*.

2. Decline in full: *nubes*, *dies*, *idem*, *alius*, *movens*.

3. Give gender of the following words with reason for each: *nauta*, (a sailor), *morus* (a mulberry tree), *Carthago*, *carbasus*, *lac*.

4. Compare the adjectives *gracilis*, *malus*, *nequam*, *creber* and the adverb *prope*.

5. Write the ordinal numerals from one to ten inclusive; and decline the cardinal number two.

6. Give the principal parts of the verbs from which the following forms are derived: *vivite*, *cedentia*, *jussus*, *vestit*, *ruperat*.

7. Give the imperfect and perfect subjunctive active, and the present and future participles of *fero*, *capio*, *pono*.

8. Inflect the present subjunctive and present imperative of *eo;* and the future and perfect indicative of *fio*.

9. Give the participles of the verb *loquor* and state how a deponent verb differs from a passive verb.

10. Explain the subjunctives occurring in the following sentences:

(*a*) *Facerem, si juberes.*

(*b*) *Amemus patriam.*

(*c*) *Ac fuit antea tempus, cum Germanos Galli virtute superarent.*

(*d*) *Huic mandat, Remos reliquosque Belgas adeat.*

What classes of verbs take two accusatives? What construction is used with verbs of remembering?

II. Caesar.

Translate (*Bk. II., 14*) *:—*

Pro his Divitiacus – nam post discessum Belgarum, dimissis Haeduorum copiis, ad eum reverterat—facit verba: 'Bellovacos omni tempore in fide atque amicitia civitatis Haeduae fuisse: impulsos a suis principibus, qui dicerent Haeduos, ab Caesare in servitutem redactos, omnes indignitates contumeliasque perferre, et ab Haeduis defecisse, et populo Romano bellum intulisse. Qui ejus consilii principes fuissent, quod intellegerent quantam calamitatem civitati intulissent, in Britanniam profugisse.'

Where did the Bellovaci dwell? Which are the principal verbs in the speech? What is the antecedent of *Qui?*

Translate (*Bk. IV., 5*) *:—*

His de rebus Caesar certior factus, et infirmitatem Gallorum veritus, quod sunt in consiliis capiendis mobiles et novis plerumque rebus student, nihil his committendum existimavit. Est enim hoc Gallicae consuetudinis, uti et viatores etiam invitos consistere cogant, et quid quisque eorum de quaque re audierit aut cognoverit quaerant; et mercatores in oppidis vulgus circumsistat, quibusque ex regionibus veniant quasque ibi res cognoverint pronuntiare cogant.

How long was Caesar in Gaul? *Cogant*, why subjunctive?

III. Cicero.

Translate (*Cat. II., § 13*) *:—*

Hic ego vehemens ille consul, qui verbo civis in exsilium eicio, quaesivi a Catilina in nocturno conventu ad M.

Laecam fuisset necne. Cum ille, homo audacissimus, conscientia convictus, primo reticuisset, patefeci cetera: quid ea nocte egisset, quid in proximam constituisset, quem ad modum esset ei ratio totius belli descripta, edocui.

Why is *fuisset* in the subjunctive? What is the difference between *homo* and *vir?*

Translate (*Cat. IV.*, §18):—

Quae cum ita sint, patres conscripti, vobis populi Romani praesidia non desunt: vos ne populo Romano deesse videamini providete. Habetis consulem ex plurimis periculis et insidiis atque ex media morte, non ad vitam suam, sed ad salutem vestram reservatum. Omnes ordines ad conservandam rem publicam mente, voluntate, voce consentiunt.

(*Archias*, §26):—

Itaque, credo, si civis Romanus Archias legibus non esset, ut ab aliquo imperatore civitate donaretur perficere non potuit. Sulla cum Hispanos donaret et Gallos, credo hunc petentem repudiasset: quem nos in contione vidimus, cum ei libellum malus poeta de populo subjecisset, quod epigramma in eum fecisset, tantummodo alternis versibus longiusculis, statim ex eis rebus quas tunc vendebat jubere ei praemium tribui, sed ea condicione, ne quid postea scriberet.

How is the word *credo* used here? Explain the formation of *libellum*.

Translate (*Manilian Law*, §47):—

Reliquum est ut de felicitate (quam praestare de se ipso nemo potest, meminisse et commemorare de altero possumus, sicut aequum est homines de potestate deorum) timide et pauca dicamus. Ego enim sic existimo: Maximo, Marcello, Scipioni, Mario, et ceteris magnis imperatoribus non solum propter virtutem, sed etiam propter fortunam saepius imperia mandata atque exercitus esse commissos.

What idea was conveyed to the Roman by the word *felicitate?*

Give dates of the four men named.

IV. Vergil.

Translate (*Aen. II., 318*) :—

Ecce autem telis Panthus elapsus Achivom,
Panthus Orthryades, arcis Phoebique sacerdos,
Sacra manu victosque deos parvumque nepotem
Ipse trahit, cursuque amens ad limina tendit.
'Quo res summa loco, Panthu? Quam prendimus arcem?'
Vix ea fatus eram, gemitu cum talia reddit:
Venit summa dies et ineluctabile tempus
Dardaniae: fuimus Troes, fuit Ilium et ingens
Gloria Teucrorum; ferus omnia Juppiter Argos
Transtulit; incensa Danai dominantur in urbe.

Write out the first and third lines, dividing them into feet and marking the caesuras and the ictus. Explain the form *Achivom*. Tell who Phoebus was.

Translate (*Aen. VI., 124*) :—

Talibus orabat dictis, arasque tenebat,
Cum sic orsa loqui vates: 'Sate sanguine divom,
Tros Anchisiade, facilis descensus Averno;
Noctes atque dies patet atri janua Ditis;
Sed revocare gradum superasque evadere ad auras,
Hoc opus, hic labor est.'

How is Anchisiade declined? Who is the speaker?

V. Latin at Sight.

Caesar eo tempore cum legione una profectus ad recipiendas ulteriores civitates et rem frumentariam expediendam, qua anguste utebatur, erat ad Buthrotum, oppositum Corcyrae. Ibi certior ab Acilio et Murco per litteras factus de postulatis Libonis et Bibuli legionem relinquit; ipse Oricum revertitur. Eo cum venisset, evocantur illi ad colloquium. Prodit Libo atque excusat Bibulum, quod is iracundia summa erat inimicitiasque habebat etiam privatas cum Caesare ex aedilitate et praetura conceptas: ob eam causam colloquium vitasse, ne res maximae spei maximaeque utilitatis ejus iracundia impedirentur. — *Caes. B. Civ. III., 16.*

VI. Latin Prose Composition.

1. Caesar sent Labienus to occupy (*occupo*) the top of the mountain near the camp of the enemy. 2. They marched for fourteen days continuously lest the Romans should capture (*capio*) the ford (*vadum*). 3. The Germans were brave, of great stature [translate size (*magnitudo*) of body] and used skins (*pellis*) as clothing (*vestitus*). 4. In the consulship of Lucius Piso and Aulus Gabinius, Caesar came from Rome to Geneva. 5. If he had been less brave he could never have conquered (*vinco*) the Helvetians. 6. Caesar said that Ariovistus had most eagerly (*cupidissime*) sought (*appeto*) the friendship (*amicitia*) of the Romans during his consulship; why should any one think that he would not do his duty (*officium*)?

VII. Roman History.

1. Give an account of how the Kingship came to an end in Rome, with the date of the expulsion of the kings.

2. State the main events in the struggle for power between the patricians and the plebeians.

3. Give the life of Marius.

4. Who fought the following battles and who were victorious: Mount Vesuvius, Cannae, Zama, Philippi, Actium?

5. Give the names and dates of the first five emperors.

IX.—GREEK.

I. Grammar.

1. Write the second person singular of the present and future indicative, and the third person singular and second person plural of the perfect indicative of the compound verb *ἀπο-ἱκνέομαι*, and state which rules of vowel and consonant change are illustrated.

2. *ὁ δὲ πείθεταί τε καὶ συλλαμβάνει*—which rules of accentuation are illustrated?

3. Decline through all numbers *λέαινα*, *νοῦς*, *ἐλπίς*, *ἀνήρ*; through the singular *ταμίας*, *κέρας*, *γυνή*.

4. Compare the adjectives *ταχύς, αἰσχρος, σώφρων.*

5. Give the principal parts of *γίγνομαι, γιγνώσκω;* the synopsis (*i. e.*, first form in each mode) of the aorist passive of *στέλλω;* the inflection through the numbers and persons of the present optative of *δίδωμι*; the present participle, nominative singular (three genders) of *ἵστημι* and *τιμάω.*

6. Name five prepositions that are used with the dative and give the meaning of each.

7. What is the difference in meaning between *οἶδα γράφειν* and *οἶδα γράφων?*

8. What is the difference in meaning between *εἰ τοῦτο ἐποίει, καλῶς ἂν ἐποίει,* and *εἰ τοῦτο ἐποίησε, καλῶς ἂν ἐποίησε?*

9. Translate into Greek: But since you do not wish to proceed with (me), it is of course necessary for me either to betray[1] you and avail-myself-of[2] the friendship of Cyrus or having lied to him to go with you. Whether now I shall do what is right I know not, but at any rate I will choose you and with you I will suffer whatever may be necessary.

[1] *προδίδωμι.*

[2] *χρῶμαι.*

II. Anabasis.

1. *Translate:*

ᾤετο δὲ ἀρκεῖν πρὸς τὸ ἀρχικὸν εἶναι καὶ δοκεῖν τὸν μὲν καλῶς ποιοῦντα ἐπαινεῖν, τὸν δὲ ἀδικοῦντα μὴ ἐπαινεῖν. τοιγαροῦν αὐτῷ οἱ μὲν καλοί τε κἀγαθοὶ τῶν συνόντων εὔνοι ἦσαν, οἱ δὲ ἄδικοι ἐπεβούλευον ὡς εὐμεταχειρίστῳ ὄντι. οτε δὲ ἀπέθνησκεν ἦν ἐτῶν ὡς τριάκοντα.

Construction of *δοκεῖν, ἐπαινεῖν, συνόντων, ἐτῶν?*

2. *Translate:*

πονηρὸν γὰρ νυκτός ἐστι στράτευμα Περσικόν. οἵ τε γὰρ ἵπποι αὐτοῖς δέδενται καὶ ὡς ἐπὶ τὸ πολὺ

πεποδισμένοι εἰσὶ, τοῦ μὴ φεύγειν ἕνεκα εἰ λυθείησαν. ἐάν τέ τις θόρυβος γίγνηται, δεῖ ἐπισάξαι τὸν ἵππον Πέρσῃ ἀνδρὶ, καὶ χαλινῶσαι δεῖ, καὶ θωρακισθέντα ἀναβῆναι ἐπὶ τὸν ἵππον. ταῦτα δὲ πάντα χαλεπὰ νύκτωρ καὶ θορύβου ὄντος.

Construction of *νυκτός, φεύγειν, λυθείησαν, γίγνηται*?

3. *Translate:*

αἱ δ' οἰκίαι ἦσαν κατάγειοι, τὸ μὲν στόμα ὥσπερ φρέατος, κάτω δ' εὐρεῖαι. αἱ δὲ εἴσοδοι τοῖς μὲν ὑποζυγίοις ὀρυκταὶ, οἱ δὲ ἄνθρωποι κατέβαινον ἐπὶ κλίμακος. ἐν δὲ ταῖς οἰκίαις ἦσαν αἶγες, οἶες, βόες, ὄρνιθες, καὶ τὰ ἔγγονα τούτων. τὰ δὲ κτήνη πάντα χίλῳ ἔνδον ἐτρέφετο.

III. Homer.

1. *Translate:*

Μῆτερ, ἐπεί μ' ἔτεκές γε μινυνθάδιόν περ ἐόντα, τιμήν πέρ μοι ὄφελλεν Ὀλύμπιος ἐγγυαλίξαι, Ζεὺς ὑψιβρεμέτης. νῦν δ' οὐδέ με τυτθὸν ἔτισεν. ἦ γάρ μ' Ἀτρεΐδης, εὐρὺ κρείων Ἀγαμέμνων, ἠτίμησεν. ἑλὼν γὰρ ἔχει γέρας, αὐτὸς ἀπούρας.

Where is *ἀπούρας* made? What is the present form? What is the present of *ἔτεκες*?

2. *Translate:*

Δαιμόνι', ἀτρέμας ἦσο καὶ ἄλλων μῦθον ἄκουε, οἵ σέο φέρτεροί εἰσι, σὺ δ' ἀπτόλεμος καὶ ἄναλκις. οὔτε ποτ' ἐν πολέμῳ ἐναρίθμιος οὔτ' ἐνὶ βουλῇ. οὐ μέν πως πάντες βασιλεύσομεν ἐνθάδ' Ἀχαιοί. οὐκ ἀγαθὸν πολυκοιρανίη. εἷς κοίρανος ἔστω, εἷς βασιλεύς, ᾧ ἔδωκε Κρόνου πάις ἀγκυλομήτεω.

Make a list of the forms peculiar to Homer and add the corresponding Attic forms. Derivation of *ἄναλκις, ἐναρίθμιος, πολυκοιρανίη*?

3. *Translate:*

Εὖτ' ὄρεος κορυφῆσι Νότος κατέχευεν ὀμίχλην,
ποιμέσιν οὔ τι φίλην, κλέπτῃ δέ τε νυκτὸς ἀμείνω,
τόσσον τίς τ' ἐπὶ λεύσσει, ὅσον τ' ἐπὶ λᾶαν ἵησιν.
ὣς ἄρα τῶν ὑπὸ ποσσὶ κονίσαλος ὦρνυτ' ἀελλὴς
ἐρχομένων. μάλα δ' ὦκα διέπρησσον πεδίοιο.

Mark the quantities and feet of these five lines.

IV. Sight Reading.

Ἵνα δὲ εἰδῆτε ὅτι οὐ καινὰ ταῦτα οὗτος ποιεῖ, ἀλλὰ φύσει προδότης ἐστὶν, ἀναμνήσω ὑμᾶς τὰ τούτῳ πεπραγμένα. οὗτος γὰρ, ἐξ ἀρχῆς μὲν τιμώμενος ὑπὸ τοῦ δήμου κατὰ τὸν πατέρα Ἄγνωνα, προπετέστατος ἐγένετο τὴν δημοκρατίαν μεταστῆσαι εἰς τοὺς τετρακοσίους, καὶ ἐπρώτευεν ἐν ἐκείνοις. ἐπεὶ δ' ἤσθετο ἀντίπαλόν τι τῇ ὀλιγαρχίᾳ ξυνιστάμενον, πρῶτος αὖ ἡγεμὼν τῷ δήμῳ ἐπ' ἐκείνους ἐγένετο. ὅθεν δήπου καὶ κόθορνος ἐπικαλεῖται. καὶ γὰρ ὁ κόθορνος ἁρμόττειν μὲν τοῖς ποσὶν ἀμφοτέροις δοκεῖ, ἀποβλέπει δ' ἐπ' ἀμφότερον.

ἀντίπαλον = hostile. *ἀποβλέπειν* = to be adapted.
ἁρμόττειν = to fit. *καινός* = new.
κατά = after the manner of.
κόθορνος = buskin (a kind of shoe).
προπετής = eager.

V. History.

1. Describe the expedition of Xerxes against Greece.
2. Give a summary account of the Peloponnesian War.
3. Who was Epaminondas, and for what is he famous?
4. When was the battle of Chaeroneia fought? Where was Chaeroneia? Who were the combatants? What were the results?
5. What changes did Ephialtes and Pericles effect in the Athenian Constitution?

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26	27	28	29	30	31	...
...	...	...	...	...	...	...

NOVEMBER.

S	M	T	W	T	F	S
...	...	...	...	...	...	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	...	...	...	...	...	...

DECEMBER.

S	M	T	W	T	F	S
...	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31	...	...	...
...	...	...	...	...	...	...

1891.

JANUARY.

S	M	T	W	T	F	S
...	...	...	...	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31
...	...	...	...	...	...	...

FEBRUARY.

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
...	...	...	...	...	...	...
...	...	...	...	...	...	...

MARCH.

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	...	...	...	...
...	...	...	...	...	...	...

APRIL.

S	M	T	W	T	F	S
...	...	...	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	...	...
...	...	...	...	...	...	...

MAY.

S	M	T	W	T	F	S
...	...	...	...	...	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31	...	...	...	...	...	...

JUNE.

S	M	T	W	T	F	S
...	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	...	...	...	...
...	...	...	...	...	...	...

JULY.

S	M	T	W	T	F	S
...	...	...	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	...
...	...	...	...	...	...	...

AUGUST.

S	M	T	W	T	F	S
...	...	...	...	...	...	1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31	...	...	...	...	...

SEPTEMBER.

S	M	T	W	T	F	S
...	...	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	...	...	...
...	...	...	...	...	...	...

OCTOBER.

S	M	T	W	T	F	S
..	...	...	...	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31
...	...	...	...	...	...	...

NOVEMBER.

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	...	...	...	...	...
...	...	...	...	...	...	...

DECEMBER.

S	M	T	W	T	F	S
...	...	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	...	...
...	...	...	...	...	...	...

1892.

JANUARY.

S	M	T	W	T	F	S
...	...	...	...	...	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31	...	...	...	...	...	...

FEBRUARY.

S	M	T	W	T	F	S
...	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	...	...	...	...	...
...	...	...	...	...	...	...

MARCH.

S	M	T	W	T	F	S
...	...	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	...	...
...	...	...	...	...	...	...

APRIL.

S	M	T	W	T	F	S
...	..	...	...	...	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
..	...	...	...	...	...	...

MAY.

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	...	...	...	..
...	...	...	...	...	...	...

JUNE.

S	M	T	W	T	F	S
...	...	...	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	...
...	...	...	...	...	...	...

CALENDAR.

1890. 1890-1891.

Sept. 6, 8, 9,	Saturday, Monday and Tuesday,	Examinations for Admission.
Sept. 10,	Wednesday, . .	First Term begins.
Oct. 9,	Thursday, . .	Founder's Day.
Nov. 27,	Thursday, . .	Thanksgiving Day.
Dec. 17,	Wednesday, .	First Term ends.

1891.

Jan. 6, 7,	Tuesday and Wednesday,	Examinations for Admission to Second Term.
Jan. 7,	Wednesday, . .	Second Term begins.
Jan. 17,	Saturday, . .	Junior Prize Orations due
Feb. 11,	Wednesday, .	Ash Wednesday.
Feb. 22,	Sunday, . . .	Washington's Birthday.
March 26,	Thursday, . .	Easter Holidays begin.
March 31,	Tuesday, . .	Easter Holidays end at $8\frac{1}{4}$ A.M.
May 25,	Monday, . .	University Day Orations due.
May 27,	Wednesday, .	Theses of Seniors due.
May 27,	Wednesday, .	Senior Examinations begin.
June 8,	Monday, . .	Annual Examinations begin.
June 14,	Sunday, . .	Baccalaureate Sermon.
June 15,	Monday, . . .	Class Day.
June 16,	Tuesday, . .	Alumni Day.
June 17,	Wednesday, . .	University Day.
June 18, 19, 20,	Thursday, Friday and Saturday,	Examinations for Admission.

1891. 1891-1892.

Sept. 5, 7, 8,	Saturday, Monday and Tuesday,	Examinations for Admission.
Sept. 9,	Wednesday, . .	First Term begins.
Oct. 8,	Thursday, . .	Founder's Day.
Nov. 26,	Thursday, . .	Thanksgiving Day.
Dec. 16,	Wednesday, .	First Term ends.

1892.

Jan. 5, 6,	Tuesday and Wednesday,	Examinations for Admission to Second Term.
Jan. 6,	Wednesday, . .	Second Term begins.
June 15,	Wednesday, .	University Day.

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Gilbert Forbes Burnett,	Sci.,	New Providence, N.J.
Ellis Buchanan Byllesby,	L.S.,	Allegheny.
George Edward Chamberlain,	A.C.,	Pittston.
*Morris Llewellyn Cooke,	M.E.,	South Bethlehem.
Warren Fellman Cressman,	C.E.,	Sellersville.
*John P. Culbertson, jr.,	E.E.,	Chambersburg.
Walter Joseph Dech,	Clas.,	Bethlehem.
Jacob De Haan,	E.E.,	Leeuwarden, Nether-
Alden Brown Diven,	C.E.,	Elmira, N. Y. [lands.
Charles Malcolm Douglas,	Clas.,	Belvidere, N. J.
Robert Arthur Downey,	C.E.,	Oswego, N. Y.
Charles Hazard Durfee,	E.E.,	Fall River, Mass.
Bernard Dennis Enright,	A.C.,	South Bethlehem.
Henry Brown Evans,	M.E.,	Dayton, O.
Robert Ferriday,	C.E.,	South Bethlehem.
Arthur Haldeman Fetters,	M.E.,	Barneston.
George Harwood Frost,	M.E.,	Plainfield, N.J.
Frederick Pardee Fuller,	E.E.,	Scranton.
Robert Foster Gadd,	C.E.,	Sudlersville, Md.
Charles Willits Gearhart,	E.E.,	Danville.
Dorr Lawton Gessner,	E.E.,	Fremont, O.
Gustavus A. Gessner, jr.,	A.C.,	Fremont, O.
Harvey Hartzell Godshall,	A.C.,	Lansdale.
*Samuel Laury Graham, jr.,	E.M.,	Pinewood, Tenn.
George Hervey Hallett,	Clas.,	Pottsville.
Lee Stout Harris,	C.E.,	Silver Brook.
Claude Sanford Haynes,	C.E.,	Elmira, N. Y.
Richard Willis Heard,	E.E.,	Augusta, Ga.
Robert Culbertson HaysHeck,	M.E.,	Heckton Mills.
*Bayly Hipkins,	M.E.,	Oakland, Md.
William Emley Holcombe,	E.E.,	Lambertville, N. J.

* Not clear of conditions.

	Course.	Residence.
George Cass Hutchinson,	M.E.,	Sewickley.
Turie Seibert Ickes,	C.E.,	Newport.
John Elmer Jones,	E.M.,	Hazleton.
*William Stricklar Jones,	E.M.,	Greensburg.
Charles Lincoln Keller,	M.E.,	Chicago, Ill.
Herman Eugene Kiefer,	A.C.,	Altoona.
Schuyler Brush Knox,	C.E.,	Carthage Landing,
Harry Donaldson Leopold,	C.E.,	Tamaqua. [N.Y.
Frank Sigismund Loeb,	A.C.,	Columbia.
Owen Francis Luckenbach,	M.E.,	Bethlehem.
William Price Marr,	E.E.,	Shamokin.
Joseph O. Mathewson, jr.,	E.M.,	Augusta, Ga.
Archibald Stewart Maurice,	C.E.,	Athens.
George Holbrooke Maurice,	C.E.,	Athens.
James Edgar Miller,	C.E.,	Chicago, Ill.
William Frederick Mylander,	C.E.,	Baltimore, Md. [Mont.
Hiram Dryer McCaskey,	E.M.,	Fort Assineboine,
Matthew McClung, jr.,	C.E.,	Knoxville, Tenn.
Charles Louis McKenzie,	C.E.,	Binghamton, N. Y.
John Douglas McPherson, jr.,	E.E.,	Washington, D.C.
Clinton Ledyard Olmsted,	C.E.,	Eagle Village, N. Y.
Charles Joseph O'Neill,	E.E.,	Washington, D. C.
Nathaniel M. Osborne, jr.,	M.E.,	Norfolk, Va.
Charles William Parkhurst,	E.E.,	Hammonton, N. J.
Duncan White Patterson,	M.E.,	Safe Harbor.
John Gates Peck,	C.E.,	Stow, Mass.
Andrew Pinter,	M.E.,	Miskolcz, Hungary.
*Mervin Paul Randolph,	E.E.,	Atglen.
Raymond Bernard Randolph,	A.C.,	Montclair, N. J.
John Graham Reid,	C.E.,	Danville.
Francis Evans Richards,	C.E.,	Columbus, Miss.

* Not clear of conditions.

	Course.	Residence.
*George William Ritchey,	L.S.,	Pittsburg.
Lewis Daniel Rights,	C.E.,	Bethlehem.
Frederick Brittan Sage,	E.E.,	Hackensack, N. J.
Martin Luther Saulsbury,	C.E.,	Ridgely, Md.
*Edmund Munroe Sawtelle,	E.E.,	Washington, D. C.
Joseph A. Schloss,	A.C.,	Elmira, N. Y.
Armin Schotte,	C.E.,	New York City.
Frank Schutte,	M.E.,	Philadelphia.
William Frederick Semper,	A.C.,	Philadelphia.
Alexander Beatty Sharpe,	E.M.,	Steubenville, O.
Adelbert Sheldon,	C.E.,	Royalton, N. Y.
Noel W. Smith,	C.E.,	Williamsport.
Edward Augustus Soleliac,	M.E.,	Allentown.
Alfred Earnest Speirs,	Clas.,	Bethlehem.
George Stern,	Clas.,	Frostburg, Md.
William Renick Stinemetz,	E.E.,	Washington, D. C.
John Taylor, jr.,	A.C.,	Bethlehem.
*Wilson Jones Taylor,	C.E.,	Edgmont.
C. Wickliffe Throckmorton,	M.E.,	Fort Schuyler, N. Y.
Lewis Esler Troutman,	M.E.,	Pottsville.
Orson William Trueworthy,	E.E.,	Washington, D. C.
Jacob Von Maur,	C.E.,	West Pittston.
Fred Conover Warman,	C.E.,	Washington, D. C.
William J. Weatherby,	E.M.,	Swedesboro, N. J.
James Horatio Westcott, jr.,	Sci.,	Wilmington, Del.
John Lewis Williams,	E.M.,	Wilkes Barre.

* Not clear of conditions.

FRESHMAN CLASS.

	Course.	Residence.
Henry Adams,	A.C.,	South Bethlehem.
*Alvord Anderson,	A.C.,	Montclair, N. J.
*William Conklin Anderson,	E.E.,	New York City.
David Balliet,	C.E.,	Normal Square.
William Maclay Bard,	E.E.,	Washington, D. C.
Robert Josiah Bartholomew,	M.E.,	Bath.
Geo. Washington Scott Baton,	C.E.,	Philadelphia.
Irvin Isaac Beinhower,	M.E.,	Steelton.
Haldeman Bigler,	A.C.,	Harrisburg.
Henry M. A. Blun, jr.,	E.E.,	Savannah, Ga.
Thomas Joseph Bray, jr.,	M.E.,	Warren, O.
Charles Sumner Bricker,	M.E.,	Lititz.
*Lawrence Calvin Brink,	C.E.,	Frenchtown, N. J.
Ernott Davis Buel,	C.E.,	Cumberland, Md.
John Salmon Carman,	A.C.,	Washington, D. C.
William Colwell Carnell,	A.C.,	Philadelphia.
Thomas Francis Carroll,	L.S.,	Long Valley.
Robert Edes Chetwood, jr.,	E.E.,	Elizabeth, N. J.
Edward Perrine Cody,	C.E.,	Philadelphia.
William Wheeler Coleman,	E.M.,	South Bethlehem.
*Homer Frank Cox,	E.E.,	Wellsboro.
*Henry Benning Crawford,	C.E.,	Columbus, Ga.
Mott Cessna Cunningham,	Sci.,	Youngstown, O.
George Milton Curtis, jr.,	A.C.,	New York City.
John Denman, jr.,	M.E.,	Kendall Creek.
John Patrick Donohoe,	E.M.,	Greensburg.
Beekman DuBarry, jr.,	M.E.,	Washington, D. C.

* Not clear of conditions.

	Course.	Residence.
Paris Milton Dunnington,	E.M.,	Minneapolis, Minn.
Walter Sewell Dunscomb,	C.E.,	Brooklyn, N. Y.
*Stephen Elliott,	C.E.,	Beaufort, S. C.
Thaddeus Percival Elmore,	C.E.,	Elmira, N. Y.
Theodore Gwathmey Empie,	E.E.,	Wilmington, N. C.
Albert Brodhead Enbody,	C.E.,	Mauch Chunk.
Alfred Howell Exton,	E.M.,	High Bridge, N. J.
Benjamin Franklin Faust,	E.E.,	Berwick.
James DuBose Ferguson,	C.E.,	Washington, D. C.
Richard Daniel Floyd,	A.C.,	Milton, Mass.
John Jacob Frank,	E.E.,	Columbia.
Andrew Gallagher,	E.E.,	South Bethlehem.
Albert Ross Gee,	E.E.,	Fall River, Mass.
Frank Wieseman Glading,	E.E.,	Philadelphia.
Milton Brayton Graff,	A.C.,	Glendale, O.
Elwood Aristides Grissinger,	E.E.,	Mechanicsburg.
Samuel Wilbur Grubb,	C.E.,	Philadelphia.
Bayard Guthrie,	E.E.,	Fort Sill, Indian Ty.
Peter Wilson Hairston,	E.E.,	Walnut Cove, N. C.
William McCleery Hall,	C.E.,	Lancaster.
*Fletcher Dickerman Hallock,	E.E.,	Plainfield, N. J.
Robert Rieman Harvey,	E.E.,	Wilkes Barre.
Arthur Williston Henshaw,	E.E.,	Amherst, Mass.
Anton Yost Hesse,	C.E.,	Bethlehem.
Ira Miller Higbee,	C.E.,	Watsontown.
Foster Haven Hilliard,	C.E.,	Beltsville, Md.
William Jacob Hiss, jr.,	E.E.,	Baltimore, Md.
Matthias Harry Holz,	E.E.,	Philadelphia.
Alfred A. Howitz,	M.E.,	West Pittston.
James Edward Hughes,	Clas.,	Philadelphia.
Geo. Washington Hunsicker,	A.C.,	Allentown.

* Not clear of conditions.

	Course.	Residence.
Charles Borrows Jacobs,	E.M.,	South Bethlehem.
Henry Scudder Jaudon,	C.E.,	Savannah, Ga.
Fred. Kittredge Jenney,	Clas.,	Kansas City, Mo.
Guillermo Enrique Jimeno,	M.E.,	Bananquilla, U.S.Col-
*Victor Albert Johnson,	E.M.,	St.Paul, Minn. [ombia.
Barry Holme Jones,	E.M.,	Bethlehem.
Wm. Harrison Kavanaugh,	M.E.,	Williamsport.
Henry Whitman Kern,	M.E.,	Chicago, Ill.
Robert Burt Kernohan,	E.M.,	Warren, O.
Henry Edward Kip,	Arch.,	Buffalo, N. Y.
Richard Warren Knight,	C.E.,	Hammonton, N. J.
Clifton Cookman Knorr,	C.E.,	Bloomsburg.
*Louis John Krom,	A.C.,	Plainfield, N. J.
*Claude Averett Langdon,	C.E.,	Chambersburg.
*Edward Kent Leech,	E.E.,	Washington, D. C.
*Arthur Hughes Lewis,	Sci.,	Plains.
James Edwin Little,	M.E.,	Hokendauqua.
John Thomas Little,	A.C.,	Hokendauqua.
Philip Theodore Lovering,	E.E.,	Minneapolis, Minn.
Clarence Oliver Luckenbach,	M.E.,	Bethlehem.
Edward Marsh,	A.C.,	Ridley Park.
John Vansickle Martenis,	M.E.,	South Bethlehem.
Fred. Chandler Mathewson,	E.M.,	Pomfret, Conn.
William Spencer Merrill,	Clas.,	Cincinnati, O.
Walter Chambers Miller,	A.C.,	Sewickley.
Walter Henry Miller,	M.E.,	Osage City, Kan.
Rudolph C. Möllman,	E.E.,	Germantown.
Charles Asher Moore,	C.E.,	Hammonton, N. J.
*George Hamilton Moorhead,	C.E.,	Harrisburg.
Spencer Mussey,	A.C.,	Washington, D. C.
Arthur McAllister, jr.,	C.E.,	Cleveland, O.

* Not clear of conditions.

	Course.	Residence.
Francis Marion McCullough,	E.E.,	Altoona.
*Matthew McHugh,	M.E.,	South Bethlehem.
Carl Wm. Frederick Neuffer,	C.E.,	Scranton.
Charles Atwood Newbaker,	E.E.,	Danville.
Alphonso Robert Nicholson,	A.C.,	Jenkintown.
Richard Leslie Ogden,	A.C.,	Shenandoah.
Godwin Ordway,	E.M.,	Washington, D. C.
Englebert Glover Ovenshine,	C.E.,	Fort Davis, Tex.
Jeremiah Francis O'Hearn,	C.E.,	Shenandoah.
Edward Boteler Passano,	M.E.,	Baltimore, Md.
William Arthur Payne,	Arch.,	Brooklyn, N. Y.
Benjamin Rush Petrikin,	E.E.,	Lock Haven.
William Vaughan Pettit, jr.,	E.M.,	Philadelphia.
Joseph Philips, jr.,	E.M.,	Nashville, Tenn.
Van Dyke Piper,	E.E.,	Bethlehem.
Wilbur Orton Polhemus,	C.E.,	Nyack, N. Y.
William Miller Purman,	M.E.,	Washington, D. C.
Edmund Payton Ramsey,	E.E.,	Washington, D. C.
*Charles Allen Rea,	E.E.,	Mill Green, Md.
Joel Howard Reber,	E.E.,	Allentown.
Homer Austin Reid,	C.E.,	Warren, O.
Jas. Clement Richardson, jr.,	E.E.,	Glendale, O.
Samuel Neely Riter,	M.E.,	Corapolis.
Luis Rivas,	M.E.,	New York City.
*Thomas Charles Roderick,	C.E.,	Canal Dover, O.
Frank William Roller,	M.E.,	Bethlehem.
Charles Beecher Rutter,	E.M.,	Lansford.
Clement Clarence Rutter,	C.E.,	Lansford.
Herman Schneider,	Arch.,	Summit Hill.
Benj. Ferdinand Schomberg,	M.E.,	Altoona.
E. A. Schuman,	E.M.,	Santiago de Cuba.

* Not clear of conditions.

	Course.	Residence.
John Scanlin Scott,	E.E.,	Wilkes Barre.
Edgar Earnest Seyfert,	C.E.,	Pine Grove.
George Elwood Shepherd,	E.E.,	Wilkes Barre.
Edward Miles Shepp,	C.E.,	Tamaqua.
Charles Elder Shipley,	E.E.,	Baltimore, Md.
Howard Barry Shipley,	C.E.,	Baltimore, Md.
Edwin Harrison Sigison,	E.E.,	Buffalo, N. Y.
Robert Eugene Smith,	M.E.,	West Bethlehem.
Charles Smithers,	E.E.,	New York City.
Francis Sidney Smithers, jr.,	E.E.,	New York City.
Richard Andrew Lee Snyder,	M.E.,	Carlisle.
Herbert Ridley Stratford,	A.C.,	Jersey City, N. J
Walter Christian Swartz,	M.E.,	Allentown.
Frederick George Sykes,	E.E.,	Apponang, R. I.
Charles Baldwin Teal,	E.E.,	Elizabeth, N. J.
Walter Allison Thacher,	C.E.,	Moorestown, N. J.
*Charles Hamilton Thompson,	E.E.,	Berryville, Va.
Elmer Grant Tice,	L.S.,	Bethlehem.
Alfred Dana Tidball,	E.E.,	South Bethlehem.
*Philip Henry Trout, jr.,	E.E.,	Staunton, Va.
Clarence Porter Turner,	E.E.,	Wilkes Barre.
Charles W. Underwood,	E.E.,	Shepherdstown.
John Moore Van Cleve,	E.E.,	Sewickley.
Everett Pike Van Mater,	M.E.,	Washington, D. C.
John Harrison Walker,	C.E.,	Scranton.
Alonzo Leach Ware,	C.E.,	Ocean City, N. J.
Edward Olmsted Warner,	E.E.,	Salisbury, Conn.
Winfield Lemuel Warner,	M.E.,	Brooklyn, N. Y.
Ruel Chaffee Warriner,	E.M.,	Montrose.
John Eugene Weideman,	E.E.,	Washington, D. C.
Howard Perry Weir,	M.E.,	New York City.

* Not clear of conditions.

	Course.	Residence.
John Ignatius Welsh,	E.E.,	Shamokin.
Aubrey Weymouth,	C.E.,	Richmond, Va.
Joseph Wheeler, jr.,	E.E.,	Wheeler, Ala.
Henry Blackstone Wilkins,	A.C.,	Baltimore, Md.
Thomas William Wilson,	E.E.,	Harrisburg.
Walter Lyne Wilson,	E.E.,	Washington, D. C.
Weldon Burris Wooden,	C. E.,	Hampstead, Md.
Charles Rusk Yerrick,	M.E.,	Danville.

SPECIAL STUDENTS.

	Course.	Residence.
Frank Collins,	E.E.,	Smyrna, Del.
Augustus Francis Horne,	A.C.,	Allentown.
Hagime Ichikawa,	A.C.,	Tokio, Japan.
Albert Edward Juhler,	A.C.,	Pomeroy, O.
Emil Herman Mohr,	E.E.,	Philadelphia.
Joseph Gillis Patterson, jr.,	L.S.,	Philadelphia.
Winston Kent Pendleton,	A.C.,	Eustis, Fla.
Stephen Collins Potts,	A.C.,	Altoona.
Frank Hiram Walker, B.S.,	C.E.,	Kilbourn, Wis.
Robert J. Waltman,	E.E.,	Bethlehem.
George Francis Weida,	A.C.,	Lawrence, Kan.
Frank Shriver West,	A.C.,	Philadelphia.

SUMMARY OF STUDENTS BY STATES.

New Hampshire,	1
Massachusetts,	8
Rhode Island,	1
Connecticut,	3
New York,	35
New Jersey,	26
Pennsylvania,	208
Delaware,	3
Maryland,	18
District of Columbia,	24
Virginia,	6
North Carolina,	3
South Carolina,	3
Georgia,	9
Alabama,	3
Florida,	2
Mississippi,	1
Kentucky,	2
Tennessee,	3
Ohio,	22
Illinois,	6
Michigan,	1
Wisconsin,	1
Minnesota,	5
Missouri,	1
Kansas,	2
Nebraska,	2

Texas,	1
Colorado,	1
Montana,	1
Indian Territory,	1
Cuba,	3
Porto Rico,	1
U. S. of Colombia,	2
Canada,	1
Netherlands,	1
Hungary,	1
Asia Minor,	1
Japan,	1
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SUMMARY OF STUDENTS BY CLASSES AND COURSES.

	Graduates.	Seniors.	Juniors.	Sophomores.	Freshmen.	Specials.	Totals.
Classical,	6	3	3	5	3	—	20
Latin-Scientific,	2	1	—	2	2	1	8
Science and Letters,	2	—	—	2	2	—	6
Civil Engineering,	3	20	21	34	38	1	116
Mechanical Eng.,	1	7	11	18	28	—	63
Mining Eng.,	10	6	13	8	15	—	52
Electrical Eng.,	—	11	10	19	50	3	91
Analytical Chem.,	3	7	3	11	18	7	47
Architecture,	—	1	—	—	3	—	4
Totals,	27	56	61	99	159	12	414

THE LEHIGH UNIVERSITY.

ORIGIN.

The Hon. ASA PACKER, of Mauch Chunk, during the year 1865, appropriated the sum of Five Hundred Thousand Dollars, to which he added one hundred and fifteen acres of land in South Bethlehem, to establish an educational institution in the rich and beautiful Valley of the Lehigh. From this foundation rose THE LEHIGH UNIVERSITY, incorporated by the Legislature of Pennsylvania in 1866. In addition to these gifts, made during his lifetime, Judge Packer by his last will secured to the University an endowment of $1,500,000, and to the University Library one of $500,000.

DESIGN.

The original object of Judge Packer was to afford the young men of the Lehigh Valley a complete education, technical, literary and scientific, for those professions represented in the development of the peculiar resources of the surrounding region. In furtherance of this purpose instruction is liberally provided in Civil, Mechanical, Mining and Electrical Engineering, Chemistry, Metallurgy, Architecture, and in all needful collateral studies. A School of General Literature is also established and thoroughly equipped, with three departments, called respectively the Classical, the Latin-Scientific, and that of Science and Letters. These departments are kept up to the standard, and the requirements for entrance are the same as those of our best Classical and Literary institutions.

FREE TUITION.

All these educational facilities are provided without charge. Through the generosity of the founder, the Trustees were enabled, in 1871, to declare tuition FREE in all

branches and classes. The Lehigh University is open to young men of good character and suitable preparation from every part of our own land and of the world. To this fact the attention of the pupils of our public schools and of the graduates of classical institutions is especially called. Thus is offered, *without charge*, every facility for studying the professions of the Civil, Mechanical, Mining and Electrical Engineer, and of the Metallurgist, the Analytical Chemist and Architect. In the Classical and Scientific departments of the School of General Literature instruction is given in the Classics, Science and Letters.

PUBLIC WORSHIP.

Prayers are held in the Packer Memorial Church of the University every morning and all students are required to be present.

Divine service is held every Sunday morning in the church. The service is according to the forms of the Protestant Episcopal Church, under whose auspices the University was placed by its Founder. Attendance is required of every student, except in case of those connected with other religious bodies, to whom the President will grant permission at the beginning of each term (if requested by the parent or guardian, or by the student himself if he be 21 years of age) to attend during that term the place of worship of the body with which he is connected, where attendance on Sunday morning will be required.

SITE.

The situation of the institution is healthful and beautiful. The region is famous for its railway and manufacturing enterprises; it possesses some of the richest iron and coal mines in our land, and thus gives the students rare facilities for confirming the teachings of the recitation room by the observation of the eye.

The University buildings are about a half-mile from the depot, at the junction of the Lehigh Valley and North Pennsylvania Railroads. New York is ninety-two and Philadelphia fifty-four miles distant.

BUILDINGS.

PACKER HALL,

named after the Founder, stands seven hundred feet back of Packer Avenue, at the base of the South Mountain. It is built of stone, and contains Lecture and Recitation Rooms, the Drawing Rooms and the Museum of Geology and Natural History.

THE CHEMICAL LABORATORY

is thoroughly fire-proof, is built of sandstone, and is 219 feet in length by 44 in width.

There are two principal stories and a basement. The upper floor is occupied by the quantitative and the qualitative chemical laboratories, the former accommodating 48 and the latter 84 students. These rooms are 20 feet in height, and are well lighted and ventilated. A laboratory for industrial chemistry and the supply room are also on this floor.

The first floor contains a large lecture room, a recitation room, a chemical museum and laboratories for organic, physiological, agricultural and sanitary chemistry.

In the basement is the large laboratory for the furnace assay of ores and a well appointed laboratory for gas analysis, also rooms containing the apparatus for several processes in industrial chemistry, the engine and air-pump for vacuum filtration, a store room and the toilet.

A photographic laboratory is located in the third story of the central portion of the building.

THE METALLURGICAL LABORATORY

contains a lecture room, a blowpipe laboratory for class instruction in blowpipe analysis and in the practical determination of crystals and minerals, a museum for mineralogical and metallurgical collections, a mineralogical laboratory provided with a Fuess reflecting goniometer, a polariscope, a Groth's "universal apparat" and a Rosenbusch polarizing microscope, a dry laboratory provided with furnaces for solid fuel and for gas with natural draught and with blast, and a wet laboratory for ordinary analytical

work. It is arranged for the instruction of classes in the courses of mineralogy, metallurgy and blowpipe analysis of the regular curriculum, and to afford facilities to a limited number of advanced students for familiarizing themselves with the methods of measurement and research employed in mineralogy and metallurgy, and for conducting original investigations in these departments of science.

THE PHYSICAL LABORATORY

consists of three stories. A large lecture room, with a seating capacity of 150, occupies a portion of the second and third floors. It is well lighted and adapted to its purposes. On the remainder of these floors are two rooms, each 40 feet long, for Heat and Light laboratories, a dark room for photographic work, spectroscopic and apparatus rooms and the private laboratories of the Instructors.

The lower floor is devoted to the use of the students in Electricity. A large room nearly 40 feet square is used as the Electrical Laboratory. There are smaller rooms for photometric and spectroscopic work, also reading, balance, apparatus and engine rooms. On this floor a 12 horse-power high speed engine and a dynamo supply two systems of electric lights, one of 25 incandescent lights, the other of four arc lights, for practical tests in the Electrical Laboratory and for experimental purposes in the lecture room above. In the cellar are battery, store rooms, etc.

The tower and two rooms in the east end of Christmas Hall have been given to the Department of Physics and will be equipped as a Meteorological Observatory.

THE SAYRE OBSERVATORY.

Near Brodhead Avenue is the Sayre Observatory, the gift of Robert H. Sayre, Esq., of South Bethlehem, containing an equatorial and a zenith telescope, transit instrument and astronomical clock.

THE UNIVERSITY LIBRARY.

To the east of Packer Hall is the University Library, erected by the Founder in memory of Mrs. Lucy Packer Linderman, his daughter.

THE GYMNASIUM

is a handsome and spacious structure, built and equipped with the utmost thoroughness. It is furnished with the best patterns of gymnastic apparatus, besides Dr. Sargent's system of Developing Appliances. It is provided with hot and cold water; tub, sponge and shower baths, and 380 clothes closets. Opportunities for recreation and amusement are provided in the bowling alleys. It is under the immediate care of a skilled and competent Director.

All students are required to undergo a physical examination before being allowed the use of the Gymnasium, and this examination will be repeated once each year during their stay at the University. The proper exercise is prescribed and is required of every student. The aim of the institution is to promote a harmonious, symmetrical development suited to the individual condition of the student.

EXPENSES.

Tuition is FREE in all branches and classes. Books, materials, paper, pencils, chemical materials used in the analytical laboratories and drawing instruments are furnished by the student. Materials consumed in the analytical laboratories are furnished to the student by the University at cost prices, their value being covered by a deposit made at the opening of that term in which the laboratory work is to be done.

Rooms and Board can not be had in University buildings, but can readily be obtained in many private houses.

The following is an estimate of the necessary expenses for the collegiate year, clothing and traveling not included:

Board for 40 weeks, . . .	from $160 to $200
Room-rent, with fuel and lights .	40 " 80
Care of room and use of furniture, .	5 " 20
Washing and incidentals, . . .	20 " 40
Books, stationery, etc., . . .	25 " 50
Total, ...	$250 to $390

NOTE.—If clubs be formed the cost of board need not exceed $3.50 per week.

ADMISSION OF STUDENTS.

The Register is intended to give all necessary information concerning the admission of students. Application may be made to the President of the University if information is desired which is not given in the Register.

DATE OF EXAMINATIONS.

Examinations for admission to the University are held at the opening of each term, and also in June at the close of the Academic year.

The examinations for 1891 will be on Tuesday and Wednesday, January 7 and 8, for admission to the *second term;* on Thursday, Friday and Saturday, June 19, 20 and 21, and on Saturday, Monday and Tuesday, September 6, 8 and 9, for admission to the first term. No other examinations for entrance will be held, except for good cause, and all applicants *must* be in attendance at 9 o'clock on the morning of the first day.

The examinations are held in the following order:

First Day.—Geography, 9 A.M.; Arithmetic, 11 A.M.; Physics, 2 P.M.; Latin and Roman History, 2 P.M.

Second Day.—Geometry, 9 A.M.; Physical Geography, 11 A.M.; United States History, 2 P.M.; Grammar, 4 P.M.

Third Day.—Algebra, 9 A.M.; Greek and Greek History, 2 P.M.

CHARACTER OF THE EXAMINATIONS.

The examinations are rigorous and cover the entire ground laid down in the following scheme. They are all conducted in writing, supplemented by an oral examination at the option of the examiner.

Each candidate for admission must be at least sixteen years of age and must present a testimonial of good moral character from his last Instructor, or from the School or

Institute to which he last belonged, or from some reputable citizen of the community in which he lives.

Candidates for admission to

THE CLASSICAL COURSE

will be examined in the following subjects:

1. *English Grammar*, including composition, spelling and punctuation.
2. *Geography*, general and political.
3. *History of the United States*, including the *Constitution*

ERRATUM. Page 34, lines 11 and 12, for September 6, 8 and 9, read September 5, 7 and 8.

Comparison and Measurement of the Surfaces of Rectilinear Figures.

[Chauvenet's Geometry (four books) is recommended, that being the text-book used in the University.]

7. *Physical Geography.*
8. *Latin Grammar.*
9. *Cæsar*, four books of the Gallic war.
10. *Cicero*, six orations, including the four against Catiline.
11. *Vergil*, the first six books of the Æneid, including Prosody.
12. The translation, at sight, of passages from Cæsar and Cicero.
13. The translation of English into Latin. (As special importance is given this part of the examination, it is suggested to teachers that they connect exercises in making

ADMISSION OF STUDENTS.

The Register is intended to give all necessary information concerning the admission of students. Application may be made to the President of the University if information is desired which is not given in the Register.

morning of the first day.

The examinations are held in the following order:

First Day.—Geography, 9 A.M.; Arithmetic, 11 A.M.; Physics, 2 P.M.; Latin and Roman History, 2 P.M.

Second Day.—Geometry, 9 A.M.; Physical Geography, 11 A.M.; United States History, 2 P.M.; Grammar, 4 P.M.

Third Day.—Algebra, 9 A.M.; Greek and Greek History, 2 P.M.

CHARACTER OF THE EXAMINATIONS.

The examinations are rigorous and cover the entire ground laid down in the following scheme. They are all conducted in writing, supplemented by an oral examination at the option of the examiner.

Each candidate for admission must be at least sixteen years of age and must present a testimonial of good moral character from his last Instructor, or from the School or

Institute to which he last belonged, or from some reputable citizen of the community in which he lives.

Candidates for admission to

THE CLASSICAL COURSE

will be examined in the following subjects:

1. *English Grammar*, including composition, spelling and punctuation.

2. *Geography*, general and political.

3. *History of the United States*, including the *Constitution*.

4. *Arithmetic*, including the metric system of weights and measures.

5. *Algebra*, Fundamental Principles. Factoring. Least Common Multiple. Greatest Common Divisor. Fractions. Involution. Evolution. Radicals. Imaginary Quantities. Equations of the First and Second Degrees. Ratio. Proportion and Progressions.

[Olney's University Algebra or Meaker's Elements of Algebra is recommended for preparation.]

6. *Geometry*, Fundamental Principles. Rectilinear Figures. The Circle. Proportional Lines and Similar Figures. Comparison and Measurement of the Surfaces of Rectilinear Figures.

[Chauvenet's Geometry (four books) is recommended, that being the text-book used in the University.]

7. *Physical Geography.*

8. *Latin Grammar.*

9. *Cæsar*, four books of the Gallic war.

10. *Cicero*, six orations, including the four against Catiline.

11. *Vergil*, the first six books of the Æneid, including Prosody.

12. The translation, at sight, of passages from Cæsar and Cicero.

13. The translation of English into Latin. (As special importance is given this part of the examination, it is suggested to teachers that they connect exercises in making

Latin, both oral and written, with all the studies of the preparatory course.)

14. *Roman History.* Creighton's Primer of Roman History is suggested as indicating the amount required.

15. *Greek Grammar.*

16. *Xenophon*, Anabasis, four books.

17. *Homer*, Iliad, first three books, including Prosody. The Catalogue of Ships may be omitted.

18. The translation, at sight, of a passage from some work of Xenophon.

19. *Greek History.* Fyffe's Primer of Greek History is suggested.

20. Writing Greek with accents.

The pronunciation of Greek according to the written accents is followed in the University, and it is desirable that students preparing to enter be taught this system.

Latin is pronounced according to the system generally known as the Roman Method.

THE LATIN-SCIENTIFIC COURSE.

Candidates for admission to this course must present the first fourteen of the above requirements, but will substitute for the Greek sections (numbers 15-20 inclusive) the following:

21. *Geometry*, Regular Polygons. Measurement of the Circle. Maxima and Minima of Plane Figures, and Plane and Polyhedral Angles; these constituting the subject matter of Books Five and Six of Chauvenet's Geometry.

THE COURSE IN SCIENCE AND LETTERS.

Candidates for admission to this course are examined in all the subjects demanded of those entering the Latin-Scientific Course, except the Latin and Physical Geography sections (numbers 7-14 inclusive). They will also present the following:

22. *Elementary Physics.*

[Avery's Elements of Natural Philosophy (revised edition) is recommended; also Gage's Elements of Physics, if studied as intended by the author, with practical work in the laboratory by the student and the calculation of problems arising in the work.]

THE SCHOOL OF TECHNOLOGY.

Candidates for admission to the Courses in Civil Engineering, Mechanical Engineering, Mining, Metallurgy, Electrical Engineering, Chemistry and Architecture will be examined in the following subjects:

1. *English Grammar*, including composition, spelling and punctuation. It is recommended that candidates have a knowledge of Latin Grammar, although an examination in it is not required for any courses except the Classical and the Latin-Scientific.

2. *Geography*, general and political.

3. *History of the United States*, including the *Constitution*.

4. *Arithmetic*, including the metric system of weights and measures.

5. *Algebra*, Fundamental Principles. Factoring. Least Common Multiple. Greatest Common Divisor. Fractions. Involution. Evolution. Radicals. Imaginary Quantities. Equations of the First and Second Degrees. Ratio. Proportion and Progressions.

[Olney's University Algebra or Meaker's Elements of Algebra is recommended for preparation.]

6. *Geometry*, Fundamental Principles. Rectilinear Figures. The Circle. Proportional Lines and Similar Figures. Comparison and Measurement of the Surfaces of Rectilinear Figures. Regular Polygons. Measurement of the Circle. Maxima and Minima of Plane Figures, and Plane and Polyhedral Angles; these constituting the subject matter of the first six books of Chauvenet's Geometry.

[Chauvenet's Geometry is recommended, that being the text-book used in the University.]

7. *Elementary Physics.*

[Avery's Elements of Natural Philosophy (revised edition) is recommended; also Gage's Elements of Physics, if studied as intended by the author, with practical work in the laboratory and the calculation of problems arising in the work.]

Division of Entrance Examinations.

Candidates for admission to the Freshman Class may pass all the examinations *at once* in June, or in September, or may take them in *two consecutive years*. In the latter case,

for the Technical courses and the course in Science and Letters, candidates may present themselves for examination in the first year in the following subjects: English Grammar, Geography, History of the United States, and Arithmetic. No credit will be given unless the candidate has passed satisfactorily in at least three subjects at one examination.

The examinations in Algebra, Geometry and Physics must be passed in June or September of that year in which the candidate proposes to enter the University.

In the Latin-Scientific and Classical courses candidates may present themselves for examination in the first year in the following subjects: English Grammar, Geography, History of the United States, Arithmetic, Physical Geography, and Roman History. No credit will be given unless the candidate has passed at least four of the subjects at one examination.

The examination in Latin may also be divided, but no credit will be given unless the candidate has passed in at least three of the topics specified at one examination. The examination in the remaining subjects must be passed in June or September of that year in which the candidate proposes to enter the University.

Candidates intending to enter the University in September are advised to present themselves for examination in June; if they are not fully prepared at that time they will receive credit for the examinations then satisfactorily passed.

CONDITIONAL ADMISSION.

A candidate failing to pass in one or more of the subjects required for admission may, at the discretion of the Faculty, be admitted to his class conditionally, to make up his deficiencies by extra study. When they are made up, he will be received into full standing in his class.

SPECIAL STUDENTS.

Young men of advanced standing who do not desire to take a full regular course, can enter and select special

shorter courses, with the sanction of the Faculty; but in all cases satisfactory examinations must be passed upon the subjects required for entrance to the Freshman Class.

ADMISSION TO ADVANCED STUDIES.

Candidates for admission to advanced studies *in any course* are required to pass, *in addition to the entrance examinations for that course*, examinations in the work already done by the classes which they desire to enter. These examinations are held on the same days as those for entrance to the Freshman Class.

The additional subjects may be found in the program of studies.

A diploma or, in so far as it covers the subjects required for entrance, a certificate of studies taken at another College will be received in lieu of the *Primary Entrance Examinations only.*

ADMISSION TO THE POST-GRADUATE COURSE.

Students of this University who have taken their *first* degree, and others, on presenting a diploma of an equivalent degree conferred elsewhere, are admitted to advanced studies, according to the plan to be found in the Register under the general subject of Graduate Students.

PREPARATORY SCHOOL CERTIFICATES

are not accepted so as to dispense with the primary entrance examinations.

NOTE.—The acceptance of a certificate as evidence of proficiency in lieu of examination is at the discretion of each Professor as to the subjects in his department.

PROGRAM OF STUDIES,

Showing the number of exercises per week for each subject, and the Text-books used.

The following is presented as the general program of instruction, subject to such modifications from time to time as the Faculty may deem expedient, with the approval of the Trustees.

The names of the text-books studied are generally mentioned. The number of exercises per week in each subject is indicated by the figure in parentheses immediately following.

Two hours of drawing, three of work in the laboratory, or three of practice in the field, are regarded as equivalent to a recitation or lecture of one hour's duration.

SCHOOL OF GENERAL LITERATURE.

There are three courses in the School of General Literature of the University.

I. The Classical includes all that is prescribed in our best institutions for the degree of Bachelor of Arts (B.A.). It covers full instruction in Greek, Latin, English, French and German, Mathematics, Astronomy, Physics, Chemistry, Geology, Physiology, Hygiene, History, Psychology, Ethics, Philosophy, Political Economy and Constitutional Law.

II. The Latin-Scientific Course differs from the first in omitting Greek, taking in its place an increased amount of the Modern Languages and of Mathematics. Students completing this course receive the degree of Bachelor of Science (B.S.).

II. The Course in Science and Letters, for which the same degree is given as for the last mentioned, contains no Latin or Greek, but furnishes instead extended instruction

in French and German, History, General Literature, Mathematics and General Science.

Instruction in all of these courses is given both by recitations and by lectures.

DESCRIPTION OF THE COURSES.

GREEK.—During the first term of Freshman year the class reads several books of the Odyssey, giving attention to Epic forms and syntax, to prosody and scanning and to Homeric antiquities and mythology. The work of the second term is directed toward a thorough acquaintance with the idiom and vocabulary of Attic prose, as a preparation for rapid reading. The Œconomicus and Symposium of Xenophon and the Crito of Plato are read during the term, with sight readings from the Memorabilia and the Apology; accompanied by discussions of domestic life at Athens. The work of the year includes a thorough review-drill on the principles of Greek accidence and syntax, and exercises in Greek prose composition are required, based, during the second term, on the reading done by the class. Greek History is studied throughout the year, with special reference to the development of political institutions.

The Sophomore class takes up, during the first term, the study of Herodotus and Thucydides. Selections are made from both authors with the purpose of illustrating their best style and at the same time of presenting, from the original sources, the history of certain interesting epochs; the reading from Herodotus, after some drill on the Ionic forms, being in large part at sight. During the second term the class reads one or two plays of Euripides, with attention to the history of Greek tragedy, the life of the author and the analysis of the drama read. The lyric meters are studied, with the aim of gaining a knowledge of the rhythmical and metrical principles of Greek poetry. During this term an elective course is offered, the subject being Greek oratory, with the reading of certain orations of Lysias or Demosthenes, or both.

The Junior year is devoted to a further study of the drama, selected plays of Sophocles, Aristophanes and Æschylus being read during the year. Work is also done in the study of public and private antiquities, partly in lectures by the professor and partly in original investigation on allotted subjects by the students.

During the first term of the Senior year one of the Dialogues of Plato is read by the class. The second term is in part devoted to the reading of selected odes of Pindar, with careful study of the history of Greek lyric poetry and of the life and work of Pindar in particular. The course concludes with a review of the history of Greek literature, intended to summarize and harmonize the fragmentary views of the general subject gained from the study of particular authors and departments of literature.

LATIN.—Much of the training in the Freshman year is devoted to laying a good foundation in Latin Grammar and in the translation of English into Latin. The authors studied are used to illustrate both of these, and a large amount is read at sight in order to cultivate quickness and readiness in the student. Roman History is begun, accompanied with full comments and lectures upon points of interest. Collateral reading will also be recommended each year throughout the course. Cicero: De Senectute and De Amicitia or the Philippics, Livy and the Odes and Epodes of Horace are read this year. With the last named, training is given in Latin meters.

During this and the following year courses of lectures will be given upon Roman Antiquities in addition to a text-book. The topography of Rome with its remains, ancient life in its various aspects, and the other departments of archæology will be discussed, illustrated by the new and extensive set of magic lantern slides which have been prepared for this purpose.

The Sophomore year completes the text-book on Roman History. Prose composition is continued, and the subject of Synonyms taken up in connection with it. The Satires

and Epistles of Horace are read in the first term and in the second the Agricola and Germania, with selections from the Annals of Tacitus, or Quintilian (Bk. X), together with sight reading. An elective in Plautus is offered during this term in addition.

In the Junior year, Selected Letters of Cicero and Pliny are read, followed by Persius and several plays of Terence. The History of Roman Literature is entered upon in the second term.

The work in the Senior year opens with Lucretius, accompanied with lectures on Roman Philosophy. One of Cicero's philosophical treatises, such as the De Officiis, De Finibus, or De Natura Deorum, is taken up in the second term. After the completion of the Roman Literature, lectures will be given upon the History of the Latin Language and upon the Principles of Comparative Philology.

SANSKRIT.—An elementary course in this study, conducted by the Professor of Latin, is offered as an optional during the Senior year.

ENGLISH.—During Freshman and Sophomore years, Rhetoric is studied, both with the aid of a text-book and through practical exercises. Careful training is given in essay writing throughout the course, and orations are written and delivered during Junior and Senior years. Excellence in Oratory is encouraged by the annual contest for the Alumni Prizes, held on the 22d of February and open to the Junior class in all departments.

The Seniors receive instruction in the principles of versification and in extemporaneous discussion, and are required to write a critique of some work selected for their examination.

The History of English Literature and the Philological history of the English language are studied during Junior year. These are supplemented by a series of lectures, extending through the second term, on the relations of Literature to History.

The course is completed by a series of lectures on English and American Literature, delivered during the second term of Senior year.

MODERN LANGUAGES.—The study of modern languages is obligatory from the first term of the Sophomore year up to the close of the course. The student elects either French or German, or both, if time permits.

French.—The grammar is begun, reading being introduced immediately. The comparative and historical relations of the French to the English, and the connection of both with the Latin are carefully explained. As soon as possible the student is emancipated from the reader and takes up, in a progressive way, the reading of different authors; preference being given to modern writers, because it is considered to be of the highest importance that he acquire the language as it is, as an instrument whereby further knowledge can be obtained.

In the class-room, the language taught is used by the teacher as much as possible, in order that the ear of the pupil may become accustomed to its sound. Dictation is also employed, in order to give training in spelling. The rules of grammar are taught by numerous written exercises. In the second term of the Junior year, compositions in French are required, upon subjects which have been previously explained in French, in order that the student may become acquainted with different expressions and forms of construction. Before entering upon the study of an author's works, his life and literary achievements are discussed in French, which is translated, if necessary. In the Senior year, twelve lectures are delivered upon the History of French Literature. In addition to this, lectures in French upon the most distinguished modern authors are given to advanced students.

A weekly conversation-class affords opportunity for this kind of practice; and in it the events of the day and various historical and literary topics are discussed. Private courses of reading are also suggested to those who desire it.

German.—The German course follows the same plan as that laid down for the French, both as regards the methods employed and the opportunities afforded. The relations of English and German are dwelt upon and also those which connect the two languages with the Indo-European family.

MATHEMATICS.—The mathematical work is carried on during the Freshman and Sophomore years as follows:

Freshman year, first term, Chauvenet's Geometry, four exercises per week.

Second term, Olney's University Algebra, Plane and Spherical Trigonometry, including Mensuration and use of Logarithmic Tables, together five exercises per week throughout the term.

Sophomore year, first term, Olney's General Geometry and Davies' Analytical Geometry, four exercises per week.

Second term, Olney's Differential and Integral Calculus, four exercises per week. This term's work is elective for the Classical Course.

ASTRONOMY.—This study is taken up during the first term of the Senior year, Young's General Astronomy being used as the text-book. There are three exercises a week, and visits to the Observatory help to make the work interesting as well as profitable.

CHEMISTRY.—This study includes a complete course of lectures in Freshman year upon General Inorganic Chemistry, in which the principles of the science are fully covered. These are illustrated by experiments, and are sufficiently extended to enable a student who desires to pursue the subject further to take Analytical Chemistry as an elective in the second term of the Sophomore year. The text-book used in connection with the lectures is Fownes' Elementary Chemistry.

PHYSICS.—This important subject is presented in a course of lectures during the first term of the Sophomore year, three times a week. In the course in Science and Letters, the work in this branch is more extended and is identical with that given to the Civil and Mechanical Engineers. It

occupies five hours a week in the first term and three in the second, and covers the whole subject.

GEOLOGY.—In the second term of the Senior year, a course of lectures is given in connection with Geikie's text-book. The general principles of the science are explained, and the theories of the formation and stratification of rocks, the successive periods of the development of the earth's crust, the extinct forms of life and similar questions are treated.

PHYSIOLOGY AND HYGIENE.—These subjects are taught in a course of lectures during the Freshman year.

HISTORY, POLITICAL SCIENCE AND LAW.—The study of History begins with a course in the Political Antiquities of Greece and Rome. [See the Departments of Greek and Latin.] This is followed by the study of an outline of Universal History (with text-book), in which it is sought to give a clear view of the relations of ancient and modern states to the world's history. The same aim is then pursued in a fuller study of the Political History of Recent Times, and especially of that of England and France. During the first term of Senior year, there is a course of lectures upon the period covered by Gibbon's Decline and Fall of the Roman Empire, intended to emphasize and strengthen the impression of the interdependence of the nations and of the unity of history. This prepares the way for a course of lectures on the Philosophy of History, in which it is sought to show the relations of the sciences of Biology, Anthropology, Ethnology, Geography and Philology to the study of History and to set forth the scientific methods of that study.

The course in History is accompanied and supplemented by courses of lectures on Constitutional Law with special application to the Constitution of the United States; and also on International Law.

Instruction is given by lectures on the elements of Political Economy. The student is made familiar with the facts, methods and doctrines of the science, and is encouraged to form and present his own opinions.

LOGIC.—In this subject there is an elementary course, occupying two hours a week during the first term of Junior year. The work is done with the aid of a text-book, attention being centred on the principles of correct definition and valid proof.

MENTAL AND MORAL PHILOSOPHY. — The work in this department will be conducted chiefly by lectures, interrupted by occasional examinations. The courses at present are the following:

Outlines of Physiological Psychology. — Junior Class, second term. These lectures are founded principally on Wundt's lectures on the same subject, given in the University of Leipzig in the Summer of 1888, Wundt's Grundzüge der Physiologischen Psychologie, Ladd's Elements of Physiological Psychology, Sully's Outlines of Psychology, Carpenter's Mental Physiology, Maudsley's Physiology and Pathology of the Mind, Bain's Mind and Body, etc., with references to the works of Lotze, Weber, Fechner and Helmholtz.

The History of Philosophy. — Senior Class, both terms. First term, Ancient and Medieval Philosophy. Second term, Modern Philosophy. These lectures will include a statement of the conception and problems of Philosophy, a brief sketch of the great ethnical religions, and of the History of Oriental Philosophy. The Philosophy of the Greeks will be treated in detail, with illustrations from the writings of the philosophers.

The History of Medieval Philosophy will be prefaced by a short description of the philosophical ideas underlying Christianity, and it will contain an account of the more important Church Fathers and Schoolmen.

The History of Modern Philosophy will begin by tracing the effect on philosophical thought of the ideas contributed by the Renascence and by the Reformation. From Lord Bacon on, a detailed history of the great modern philosophical systems will be given, which will be continued to those of our own times, including Mr. Spencer.

CHRISTIAN EVIDENCES. — Senior Class, second term. Lectures on Christian Evidences, which will endeavor to treat of the subject both from the side of Natural Science and from that of Biblical Criticism.

No complete course in Ethics has as yet been established. But the History of Ethics is included in the History of Philosophy.

THE COURSE IN SCIENCE AND LETTERS

substitutes the following for the Latin and Greek.

DRAWING.—In the first term of the Freshman year the student is instructed in Elementary Projections, Shading and Lettering.

ZOÖLOGY AND BIOLOGY.—The study of these subjects covers one year, beginning with the second term of Sophomore year. The work begins with a description of the various animal functions, and is extended to the comparative anatomy and physiology of the organs in typical species. Systematic Zoölogy is then completed and followed by the theories of Biology.

CHEMISTRY. — In addition to the Course in General Chemistry described above, three exercises a week in Qualitative Analysis are taken in the second term of the Freshman year.

MINERALOGY.—Instruction in Mineralogy is given to the students in the Course in Science and Letters throughout the Junior year. In the first term, they attend a course of lectures on Crystallography, followed by a series of practical exercises in the determination of crystalline forms by the aid of models and natural crystals.

In the second term a course on the physical properties of minerals and on descriptive mineralogy, with the use of E. S. Dana's Text Book of Mineralogy, is followed by practical exercises in the determination of minerals.

GEOLOGY.—The study of Lithology is pursued in the first term of the Senior year, with laboratory practice, Williams' Lithology being used as the text-book. During the next term, the course given above is taken with the Classical and Latin-Scientific students.

THE CLASSICAL COURSE.

FRESHMAN CLASS.

FIRST TERM.

Mathematics.—Geometry (Chauvenet). (4)
Chemistry.—Lectures. Fownes' Elementary Chemistry. (4)
Greek.—Homer: Odyssey. Prosody. (3)
Latin.—Cicero: de Senectute and de Amicitia. Livy begun. Prose Composition. (2)
History.—History of Greece. (1)
Physiology and Health.—Lectures. (1)
English.—Rhetoric. Essays. (1)
Gymnasium. (2)

SECOND TERM.

Mathematics.—Olney's University Algebra, Pt. III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)
Greek.—Xenophon: Œconomicus. (3)
Latin.—Livy completed. Horace: Odes and Epodes. Composition and Prosody. (4)
History.—History of Greece. (2) History of Rome. (1) Roman Antiquities.
English.—Rhetoric. Essays. (1)
Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)
Physics.—Lectures. (3)
French.—Whitney's Practical French Grammar. Keetel's Analytical Reader. (2) Or *German.*—Brandt's Grammar. Lodeman's Manual of Exercises. Joynes' Otto's Reader. (2)
Greek.—Herodotus and Thucydides. (2)
Latin.—Horace: Satires and Epistles. Composition. (2)
History.—History of Rome. (2) Antiquities.
English.—Rhetoric. Essays. (1)
Gymnasium. (2)

SECOND TERM.

French.—Grammar and Reader (continued). (2) Or *German.*—Grammar, Exercises and Reader (continued). (2)

English.—Coppée's Rhetoric, with Kellogg's Praxis. (1)

History.—Weber's Outlines of Universal History. (2)

Greek.—Euripides: Medea. (3)

Latin.—Tacitus: Agricola, Germania and Annals, or Quintilian: Book X. Composition. (3) Antiquities.

English.—Rhetoric. Essays. (1)

Gymnasium. (2)

In addition to the above exercises, four hours per week must be selected from the following elective studies:

Mathematics.—Differential and Integral Calculus: Olney. (4)

Greek.—Demosthenes: De Corona. (2)

Latin.—Plautus. (2)

French.—Grammar and Reader. (2)

German.—Grammar and Reader. (2)

Chemistry.—Qualitative Analysis—Laboratory. (2)

JUNIOR CLASS.

FIRST TERM.

History.—Wilhelm Müller's Political History of Recent Times, and Lectures. (2)

Philosophy.—Coppée's Logic. (2)

English.—Coppée's English Literature. (4)

French.—Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

Greek.—Sophocles: Electra. Antiquities. (3)

Latin.—Letters of Cicero and Pliny. (3)

Essays and Original Orations.

Gymnasium. (2)

SECOND TERM.

History.—History of England: Hume. (3)

Philosophy.—Lectures on the Outlines of Physiological Psychology. (2) Political Economy. (1)

English.—Earl's Philology of the English Tongue. (2)

French.—O'Connor: Choix de Contes Contemporains. Sadler's Translator. Dictation. (2) Or *German.*—Buchheim's Prose Composition. Reading. Dictation. (2)

Greek.—Aristophanes: Clouds. Æschylus: Prometheus. (3)

Latin.—Persius and Terence. Cruttwell's History of Roman Literature. (3)

Literature and History. (1)

Essays and Original Orations.

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

International Law.—Lectures: Woolsey. (2)

History.—Decline and Fall of the Roman Empire: Gibbon. (3)

Philosophy.—Lectures on the History of Ancient and Mediæval Philosophy. (2)

Astronomy.—Young's General Astronomy. (3)

French.—Sadler: Readings in Corneille, Racine, Molière, etc., and contemporary authors. Compositions. Lectures on French Literature. (2) Or *German.*—Grammar. Readings in Lessing, Herder, Goethe, Schiller, etc., and contemporary authors. Compositions. Lectures on German Literature. (2)

Conversation Class in both languages optional throughout the year.

Greek.—Plato: Phædrus. Greek Philosophy. (2)

Latin.—Lucretius, with Lectures. Roman Literature. (2)

Essays and Original Orations.

Gymnasium. (2)

SECOND TERM.

Constitutional Law.—Lectures. (1)

History.—History of France. (2)

Philosophy.—Lectures on the History of Modern Philosophy. (1) Philosophy of History. Lectures. (2)

Christian Evidences.—Lectures. (1)

French.—Readings. Compositions. Lectures in French on modern French authors. (2) Or *German.*—Readings. Compositions. Lectures in German on modern German authors. (2)

Geology.—Lectures. Geikie. (2)

Greek.—Pindar: Selected Odes. Greek Literature. (2)

Latin.—Cicero: de Officiis, with Lectures. (2)

Lectures on American and English Literature. (2)

Essays and Original Orations.

Preparation of Thesis.

Gymnasium.

THE LATIN-SCIENTIFIC COURSE.

The Latin-Scientific Course, leading to the degree of Bachelor of Science (B.S.), is based on Latin without Greek.

FRESHMAN CLASS.

FIRST TERM.

Mathematics.—Geometry (Chauvenet completed). (4)

Chemistry.—Lectures. Fownes' Elementary Chemistry. (4)

German.—Joynes-Meissner's Grammar. Joynes-Otto's Reader. (3)

Latin.—Cicero: De Senectute and De Amicitia. Livy begun. Prose Composition. (2)

History.—History of Greece. (1)

Physiology and Health.—Lectures. (1)

English.—Rhetoric. Essays. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of the Logarithmic Tables. (2)

German.—Grammar. Reader (continued). (3)

History.—History of Greece. (2) History of Rome. (1) Roman Antiquities.

Latin.—Livy (completed). Horace: Odes and Epodes. Composition and Prosody. (4)
English.—Rhetoric. Essays. (1)
Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)
Physics.—Lectures. (3)
French.—Whitney's Practical French Grammar. Super's Reader. (2)
German.—Harris's Prose Composition. Reading. (2)
History.—History of Rome. (2) Antiquities.
Latin.—Horace: Satires and Epistles. Composition. (2)
English.—Rhetoric. Essays. (1)
Gymnasium. (2)

SECOND TERM.

Mathematics.—Differential and Integral Calculus: Olney. (4)
English.—Coppée's Rhetoric, with Kellogg's Praxis. (1)
French.—Grammar. Reader (continued). (2)
German.—Harris. Reading. Dictation. (2)
History.—Weber's Outlines of Universal History. (2)
Latin.—Tacitus: Agricola, Germania and Annals, or Quintilian: Book X. Composition. (3) Antiquities.
English.—Rhetoric. Essays. (1)
Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

History.—Wilhelm Müller's Political History of Recent Times, and Lectures. (2)
Philosophy.—Coppée's Logic. (2)
English.—Coppée's English Literature. (4)
French.—Grammar. Reading. (2)

German.—Readings in Lessing, Herder, Goethe, Schiller and contemporary authors. Dictation. Compositions. (2)

Conversation Class in German optional throughout the year.

Latin.—Letters of Cicero and Pliny. (3)

Essays and Original Orations.

Gymnasium. (2)

SECOND TERM.

History.—History of England: Hume. (3)

Philosophy.—Lectures on the Outlines of Physiological Psychology. (2) Political Economy. (1)

English.—Earle's Philology of the English Tongue. (2)

French.—O'Connor: Choix de Contes Contemporains. Sadler's Translator. Dictation. (2)

German.—Readings (continued). Dictation. Compositions. (2)

Latin.—Persius, Terence. Cruttwell's History of Roman Literature. (3)

Literature and History. (1)

Essays and Original Orations.

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

International Law.—Lectures: Woolsey. (2)

History.—Decline and Fall of the Roman Empire: Gibbon. (3)

Philosophy.—Lectures on the History of Ancient and Medieval Philosophy. (2)

Astronomy.—Young's General Astronomy. (3)

French.—Readings in Corneille, Racine, Molière, etc., and contemporary authors. Lectures on French Literature. (2)

German.—Readings (continued). Compositions. Lectures on German Literature. (1)

Conversation Class in both languages optional throughout the year.

Latin.—Lucretius, with Lectures. Roman Literature. (2)

Essays and Original Orations.

Gymnasium.

SECOND TERM.

Constitutional Law.—Lectures. (1)

History.—History of France. (2)

Philosophy.—Lectures on the History of Modern Philosophy. (1) Philosophy of History. Lectures. (2)

Christian Evidences.—Lectures. (1)

Geology.—Lectures. Geikie. (2)

Latin.—Cicero: de Officiis, with Lectures. (2)

French.—Readings (continued). Compositions. Lectures in French on modern French authors. (2)

German.—Readings (continued). Compositions. Lectures in German on modern German authors. (1)

Lectures on American and English Literature. (2)

Essays and Original Orations.

Preparation of Thesis.

Gymnasium.

COURSE IN SCIENCE AND LETTERS.

The Course in Science and Letters, leading to the Degree of Bachelor of Science (B.S.), is designed for those who wish to pursue both Scientific and Literary studies without Latin and Greek. These being omitted, extended instruction is given in French and German, History, General Literature, Mathematics and General Science.

FRESHMAN CLASS.

FIRST TERM.

Mathematics.—Geometry (Chauvenet completed). (4)

Chemistry.—Lectures. Fownes' Elementary Chemistry. (4)

German.—Joynes-Meissner's Grammar. Joynes-Otto's Reader. (3)

Drawing.—Elementary Projections, Shading and Lettering. (2)

History.—History of Greece. (1)

Physiology and Health.—Lectures. (1)

English.—Rhetoric. Essays. (2)

Gymnasium. (2)

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of the Logarithmic Tables. (2)

Chemistry.—Qualitative Analysis. (3)

History.—History of Greece. (2). History of Rome. (1)

German.—Grammar. Reader (continued). (3)

English.—Rhetoric. Essays. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)

Physics.—Mechanics, Heat and Electricity. Lectures. (5)

French.—Whitney's Practical French Grammar. Super's Reader. (2)

German.—Harris's Prose Composition. Readings. (2)

History.—History of Rome. (2)

English.—Essays.

Gymnasium. (2)

SECOND TERM.

Mathematics.—Differential and Integral Calculus. Olney. (4)

Physics.—Sound, Light and Meteorology. Lectures. (3)

Zoölogy.—Lectures. Orton. (2)

English.—Coppée's Rhetoric, with Kellogg's Praxis. (1)

French.—Grammar. Readings (continued). (2)

German.—Harris. Readings. Dictation. (2)

History.—Weber's Outlines of Universal History. (2)

Essays.

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

History.—Wilhelm Müller's Political History of Recent Times, and Lectures. (2)

Philosophy.—Coppée's Logic. (4)

English.—Coppée's English Literature. (4)

French.—Grammar. Readings. (2)

German.—Readings in Lessing, Herder, Goethe, Schiller and contemporary authors. Dictation. Compositions. (2)

Conversation class in German optional throughout the year.

Zoölogy.—Lectures on Biology. (2)

Crystallography.—Lectures, with practical exercises in the determination of Crystals. (2)

Essays and Original Orations.

Gymnasium. (2)

SECOND TERM.

History.—History of England: Hume. (3)

Philosophy.—Lectures on the Outlines of Physiological Psychology. (2) Political Economy. (1)

English.—Earle's Philology of the English Tongue. (2)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Sadler's Translator. Dictation. (2)

German.—Readings (continued). Compositions. (2)

Mineralogy.—Descriptive Mineralogy, with practical exercises in the determination of Minerals. (3)

Literature and History. (1)

Essays and Original Orations.

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

International Law.—Lectures: Woolsey. (2)

History.—Decline and Fall of the Roman Empire. (3)

Philosophy.—Lectures on the History of Ancient and Medieval Philosophy. (2)

Astronomy.—Young's General Astronomy. (3)

French.—Readings in Corneille, Racine, Molière, etc., and contemporary authors. Compositions. Lectures on French Literature. (2)

German.—Readings (continued). Compositions. Lectures on German Literature. (1)

In both languages Conversation class optional throughout the year.

Geology. — Williams' Lithology and Laboratory Practice. (2)

Essays and Original Orations.

Gymnasium.

SECOND TERM.

Constitutional Law.—Lectures. (1)

History.—History of France. (2)

Philosophy.—Lectures on the History of Modern Philosophy. (1) Philosophy of History. Lectures. (2)

Christian Evidences.—Lectures. (1)

French.—Readings (continued). Compositions. Lectures in French on modern French authors. (1)

German.—Readings (continued). Compositions. Lectures in German on modern German authors. (1)

Geology. — Historic, Dynamic and Economic Geology. Geikie. (2)

Lectures on American and English Literature. (2)

Essays and Original Orations.

Preparation of Thesis.

Gymnasium.

THE SCHOOL OF TECHNOLOGY.

This school includes seven distinct courses:

I. The Course in Civil Engineering.
II. The Course in Mechanical Engineering.
III. The Course in Mining.
IV. The Course in Metallurgy.
V. The Course in Electrical Engineering.
VI. The Course in Chemistry.
VII. The Course in Architecture.

These have the same curriculum of studies for the first term of the Freshman year. At the end of that time the student selects his course and follows its program.

FRESHMAN CLASS.

FIRST TERM.

Mathematics.—Chauvenet's Geometry (completed). (4)

Chemistry.—Lectures. Fownes' Elementary Chemistry. (4)

French.—Whitney's Practical French Grammar. Super's Reader. (3) Or *German.*—Joynes-Meissner's Grammar. Joynes-Otto's Reader. (3)

Drawing.—Free-Hand Sketching and Lettering. (2)

English.—Rhetoric. Essays. (1)

Physiology and Health.—Lectures. (1)

Gymnasium. (2)

THE COURSE IN CIVIL ENGINEERING.

The special technical studies in this course may be grouped under the heads of Surveying, Applied Mechanics, Road and Railroad Construction, Bridge Design, and Hydraulic and Sanitary Engineering.

The work in Surveying extends over six terms and embraces land surveying, leveling, topography, triangulation, railroad reconnaissance and location, hydrography, and the elements of geodesy. A large equipment of transits, levels and other surveying tools affords students the opportunity of becoming familiar with the instruments of different manufacturers. Much time is devoted to practice in the field and drafting room, each student being required to become proficient in the use of instruments, in taking field notes and in map-drawing. Particular attention is paid to the execution of topographical surveys and maps by the best modern methods. During the Senior year there is done secondary triangulation work of a high order of precision.

The work in Applied Mechanics comprises the strength and elasticity of materials, the theory of the equilibrium of arches, roofs and bridges, that part of the mechanics of machinery which relates to locomotives and hoisting machines, and the theory of hydraulics and hydraulic motors. Here the theoretical principles are illustrated by examples and problems taken as far as possible from actual engineering practice and a special report is required from each

student on the testing machines of the Bethlehem Iron Company.

The course in Construction familiarizes the student with the qualities of materials used in engineering structures, with methods of preservation and testing, with masonry and foundations, and with the building and maintenance of roads and railroads. Plans, drawings and estimates of cost are prepared for the construction of a line of railroad, all details, such as drains, culverts, road crossings, etc., being worked out by each student.

The course in Bridge Design is preceded by the theory of computation of stresses by both analytical and graphic methods. Starting with the specifications for a first-class iron highway or railroad bridge, each student then makes the full computations, designs, working drawings and bills of material for a plate girder and for a pin-connected truss bridge. The weight of the designed bridge is finally determined and compared with the dead load assumed for the calculations. The drawings are made and dimensioned in the same manner as in the drafting office of a bridge company. In connection with this course visits of inspection to bridges in the vicinity are regularly made.

The work in Hydraulic and Sanitary Engineering embraces the study of systems of water supply, the collection, purification and distribution of water, the combined and the separate systems of sewerage, the methods for the disposal of sewage, and the best practice for the drainage and ventilation of houses. The hydraulic laboratory in the University Park affords opportunity for experiments on the actual measurement of water by means of weirs and orifices, and the testing of hydraulic motors.

Besides these special studies there is a course in Astronomy, which includes practical work in the Observatory. The study of English, and of French or German, is continued, and instruction is given during four terms in Crystallography, Mineralogy, Lithology and Geology.

The student who completes all the studies of this course will receive the degree of Civil Engineer (C.E).

FRESHMAN CLASS.

FIRST TERM.

See page 59.

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

Surveying.—Theory of Chain and Compass Surveying. Computation of Areas. Elements of Leveling. (1)

French.—Grammar and Reader (continued). (3) Or *German.*—Grammar and Reader (continued). (3)

Drawing.—Descriptive Geometry and Isometric Drawing. Tracings. Warren's Elementary Projection Drawing. (4)

English.—Rhetoric. Essays. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)

Physics.—Mechanics, Heat and Electricity. Lectures. (5)

French.—Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

Drawing.—Isometric Drawing. Architectural Drawing. (2)

Surveying.—Use of Compass, Level and Transit. Surveys and Maps of Farms. Colored Topography. (2)

English.—Essays.

Gymnasium. (2)

SECOND TERM.

Mathematics.—Differential and Integral Calculus: Olney and Courtenay. (4)

Physics.—Sound, Light and Meteorology. Lectures. (3)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Dictation. (2) Or *German.*—Grammar. Reading. Dictation. (2)

Mechanics.—Theory of motion, statics, energy, center of gravity, moment of inertia and general equations of motion. (4)

Surveying.—Profiles and Contour Maps. Hydrographic and City Surveying. Use of the Plane Table. Topographical Drawing. (3)

English.—Essays.

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Courtenay's Calculus, and Wood's Analytical Mechanics. (2)

French.—Readings. Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation Class in both languages optional throughout the year.

Surveying.—Triangulation. Leveling. Topographical Surveying with Transit and Stadia. Topographical Map. (4)

Strength of Materials.—Elasticity and Strength of Wood, Stone and Metals. Theory of Columns, Shafts and Beams. Reports on the Testing of Materials. (4)

Construction.—Materials of Construction. Masonry. Foundations. Theory of retaining walls and stone arches. (2)

Crystallography.—Lectures, with practical exercises in the determination of crystals. (2)

Essays and Original Orations.

Gymnasium. (2)

SECOND TERM.

French.—Readings. Compositions. Lectures on French Literature. (2) Or *German.*—Readings. Compositions. Lectures on German Literature. (2)

Surveying.—Theory of Railroad Curves. Railroad Reconnaissance and Location. Survey of a Line, with Profile, Map and Estimate of Cost. (4)

Roofs and Bridges.—Theory and Calculations of Strains in Roof and Bridge Trusses. Graphic Statics. (3)

Construction.—Stone Cutting, with practical Drawings. (3) Construction and Maintenance of Roads and Railroads. (1)

Mineralogy.—Descriptive Mineralogy, with practical exercises in the determination of minerals. (3)

Literature and History. (1)

Gymnasium. (2)

SENIOR CLASS

FIRST TERM.

Astronomy.—Young's General Astronomy. (3)

Bridges.—Suspension, Continuous and Cantilever Bridges. Design of Plate Girders and Riveted Bridges, with Working Drawings. (6)

Surveying.—Use of Solar Transit and Sextant. Precise Triangulation. Elements of Geodesy. The Figure of the Earth. (3)

Mechanics of Machinery.—Pile Drivers, Cranes and Elevators. The mechanics of the Locomotive. (2)

Geology.—Williams' Lithology, with practical exercises in determining rocks. (2)

Gymnasium.

SECOND TERM.

Astronomy.—Doolittle's Practical Astronomy, with observatory work. (2)

Bridges.—Design of Pin-Connected Bridges, with working drawings. (3)

Hydraulics.—Hydrostatics. Efflux of Water from Orifices and Flow in Pipes and Rivers. Hydraulic Motors. (2)

Hydraulic and Sanitary Engineering.—Collection, Purification and Distribution of Water. Systems of Water Supply. The Combined and the Separate System of Sewerage. Disposal of Sewage. House Drainage. Hydraulic Experiments. (4)

Geology.—Historic and Dynamic. Geikie. (2)

Lectures on American and English Literature. (2)

Christian Evidences.—Lectures. (1)

Preparation of Thesis.

Gymnasium.

THE COURSE IN MECHANICAL ENGINEERING.

The object of this course is the study of the Science of Machines. The principal subjects taught are: The nature, equivalence and analysis of mechanisms, the mechanics or theory of the principal classes or types of machinery, Mechanical Technology and the principles and practice of Machine Design.

That the students may obtain the practical engineering data which they will most need when beginning their work as mechanical engineers they are required to pursue a course of Shop Instruction which does not necessarily involve manual labor and manipulation of tools, but is principally devoted to familiarizing them with those points in pattern-making, moulding, forging, fitting and finishing, which they need to know as designers of machinery. Particular attention is therefore directed to the forms and sizes of machine parts that can be readily constructed in the various workshops, to the time that it takes to perform, and the order of, the various operations, to the dimensions most needed by workmen and to the various devices for increasing the accuracy of the work, durability of the parts and convenience of manipulation. This involves acquaintance with the processes and machinery of the workshops, but it is the foreman's and superintendent's knowledge which is required rather than the manual dexterity and skill of the workman and tool-hand. The acquirements peculiar to the latter are by no means despised and the students are encouraged to familiarize themselves therewith during leisure hours, but manual work in the shops forms no regular part of the course. On the contrary, the student enters the shop with hands and mind free to examine all processes, operations and machinery, and is ready at the call of the teacher to witness any operation of special interest. Provided with note-book, pencil, calipers and measuring rule, the student sketches the most important parts of the various machine-tools, notes down the successive steps of each of the important shop-processes as illustrated by the pieces operated upon, and follows the

pieces of work through the shops from the pig or merchant form to the finished machine.

That the students may learn to observe carefully and be trained to think and observe for themselves in these matters, there is required of them a full description of the various processes, operations and tools involved in the production of each one of a series of properly graded examples of patterns, castings, forgings and finished pieces which are not being constructed in the shops at the time and the blue prints for which have been given to them on entering the shops. The student's work is directed not only by these drawings and by the printed program given him at the start, but also personally by a teacher, who accompanies him into the shops, gives necessary explanations, and tests the extent and accuracy of his knowledge by examining the sketches and notes and by frequent questioning. Finally the results of the observations and the sketches are embodied in a memoir.

During the course there are frequent visits of inspection to the Bethlehem Iron Company, the L. V. R. R. Shops at Easton, and other engineering works both in and out of town, with special reference to such subjects as Machine Elements, Prime Movers, Machinery for lifting, handling and transporting, and Machinery for changing the form and size of materials. It is intended that each of these excursions shall have some definite purpose in view which must be fully reported by the students. These visits are also made the occasion for constant practice in the Free-Hand Sketching of Machinery.

The instruction in Machine Design begins with second term of the Freshman year and is continued throughout the course. At first tracings and blue prints of good examples of machine drawings are made. A thorough drill in projection drawing follows; in this work free-hand sketches are first made, and measurements taken, of machine pieces; these sketches are then converted into full-size working drawings. Then there is considerable practice in the interpretation of such drawings, and general views of

lathes, planers, drills and shapers are made from the drawings of the details. This is followed by difficult projections and intersections and exercises in the empirical proportioning of machine parts. Both empirical and rational formulas are used to determine the dimensions of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers and connecting rods, the data being given as they would arise in practice and the drawings made full size. During the Junior year the class takes up the design of a high-speed steam engine, every dimension being determined by the students and complete drawings made. During the Senior year the students undertake the calculations, estimates and working drawings involved in the design of a simple but complete machine, each student being engaged upon a different machine. From the finished drawings of each machine tracings are made and then blue prints taken for distribution among the other members of the class. In the case of the machines and of the engine the general plan or arrangement will be given to the students in the form of rough sketches, photographs or woodcuts. In the last term the students are expected to make original designs for simple machinery, whose object has been fully explained. Throughout the course the work in the draughting-room is carried on as nearly as possible like that of an engineering establishment, and special attention is paid to methods of expediting the work of calculation by means of simple formulas, tables and diagrams.

The graduates in this course will receive the degree of Mechanical Engineer (M.E.).

FRESHMAN CLASS.

FIRST TERM.

See page 59.

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

French.—Grammar and Reader (continued). (3) Or *German.*—Grammar and Reader (continued). (3)

Drawing and Machine Design.—Tracings and blue prints. Sketches and working drawings of machine pieces. Interpretation of machine drawing by isometric sketches. General views from given details. Sections of stub ends and valve passages. Intersection of boiler flues. Empirical proportioning of machine parts. (5)

English.—Rhetoric. Essays. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)

Physics.—Mechanics, Heat and Electricity. Lectures. (5)

Machine Design.—Proportioning of such machine parts as come under the head of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers and connecting rods. (2)

Visits of Inspection.—Examination and sketching of principal machine parts in the shops of the vicinity. (2)

French.—Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

English.—Essays.

Gymnasium. (2)

SECOND TERM.

Mathematics.—Differential and Integral Calculus: Olney and Courtenay. (4)

Physics.—Sound, Light and Meteorology. Lectures. (3)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Dictation. (2) Or *German.*—Grammar. Reading. Dictation. (2)

Mechanics.—Theory of motion, statics, energy, center of gravity, moment of inertia and general equations of motion. (4)

Steam Engine.—Holmes' Steam Engine. (3)
English.—Essays.
Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Courtenay's Calculus and Wood's Analytical Mechanics. (2)

French.—Readings. Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation class in both languages optional throughout the year.

Mechanical Technology.—Shop instruction. Examination of the processes and appliances involved in pattern-making, moulding, forging, fitting and finishing, with sketches and reports. (7)

Boilers.—Wilson. Strength, construction and wear and tear of boilers. (1)

Strength of Materials.—Elasticity and strength of wood, stone and metals. Theory of beams, shafts and columns. Reports on experimental tests. (4)

Essays and Original Orations.
Gymnasium. (2)

SECOND TERM.

French.—Readings. Compositions. Lectures on French Literature. (2) Or *German.*—Readings. Compositions. Lectures on German Literature. (2)

Kinematics of Machinery.—Reuleaux. Nature and Equivalence of Mechanisms. (3)

Machine Design.—Calculations and Working Drawings for a High-Speed Steam Engine. (5)

Metallurgy.—Metallurgical Processes. Furnaces. Refractory Building Materials. Combustion. Natural and Artificial Fuels. Metallurgy of Iron. (4)

Machinery of Transmission.—Weisbach-Herrmann. (2)
Literature and History. (1)
Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Thermodynamics. — General principles; application to Steam Engines and Air Compressors. (3)

Graphical Statics.—Graphical Analysis of Roof Trusses and Girders. (2)

Machine Design.—Calculations and Working Drawings for hoisting, pumping and metal-working machinery. (4)

Kinematics.—Diagrams of the changes of position, speed and acceleration in mechanisms. Link and Valve motions. Quick return motions. Parallel motions. Laying out of Cams. (3)

Mechanics of Machinery.—Weisbach-Herrmann. Hoisting machinery, accumulators, cranes and locomotives. (4)

Gymnasium.

SECOND TERM.

Mechanics of Machinery.—Weisbach-Herrmann. Pumps, pumping engines, blowing engines, compressors and fans. (4)

Machine Design.—Original Designs. (5)

Hydraulics.—Hydrostatics. Flow of water in pipes and channels; hydraulic motors. (2)

Measurement of Power.—Indicating of Steam Engines; determination of evaporative efficiency of boilers; dynamometer experiments. (1)

Lectures on American and English Literature. (2)

Christian Evidences.—Lectures. (1)

Preparation of Thesis.

Gymnasium.

THE COURSES IN MINING AND METALLURGY.

These courses aim to fit the student for practical work in either of the branches of mining, metallurgy, metallurgical chemistry or geology. On account of the great number and scope of the studies necessary to the attainment of the degree of Engineer of Mines (E.M.), which includes that of Metallurgist, five years are required. At the end of the fourth year the student will have completed a course similar to that leading to the scientific degree in other institutions, and will receive the degree of Bachelor of Science (B.S.). At the end of the Freshman year an opportunity is given the student to select one of two courses leading to the above degrees. These allow a full course in either mining or metallurgy to be acquired in four years, and afford to the student whose time is limited and who desires to practice one of the above branches the means for rapid work. The graduate in either course can obtain the Engineer's degree (E.M.) by one year of post-graduate work. The following program of subjects and studies shows the requirements for the degree of Engineer of Mines.

Modern Languages.—Although the option of studying French or German lies with the student, it may be well to note that the current literature of the subjects taught in these courses is more abundant in the latter language.

Drawing and Construction.—The course in machine design begins in the second term of Freshman year with tracings of good examples of machine drawings; then follow the interpretation of such drawings, and the making of general views of machines from detailed sketches; exercises in projection drawing from the same, and the proportioning of simple tools and machines. In Sophomore year the metallurgist becomes acquainted with the arrangement and details of metallurgical plant and in Senior year he designs the same. The post-graduate, during the entire year, becomes acquainted with and designs mining plant. The field work in mining and geological surveying is followed by map construction from field notes. Practice in

mining and metallurgical construction is also afforded by the projects.

CHEMISTRY. — The course in theoretical and applied chemistry extends over three years and includes work in wet and dry assaying of all the important ores and metallurgical products met with in actual practice, combined with the working of stoichiometric problems and the study of chemical philosophy. The practical work is that required for a metallurgical chemist or assayer.

With moderate care the expenses in this department need not exceed $120.

MINERALOGY.—This subject is divided into two courses. In the first course, after a short exposition of the laws of crystallography and a description of crystalline forms, practical exercises are held in the determination of simple and complex crystals, in which the student is taught to identify the various crystalline forms observed in minerals by the aid of models and of actual crystals, and with the use of the application goniometer. The second course includes the subjects of physical, descriptive and determinative mineralogy. As in the first course, the greater part of the time is devoted to practical exercises which, in this course, have for their object the determination of minerals. Each student is thus enabled to become familiar with the more common minerals by the actual handling of several hundred specimens, with the facility of making such tests as will not injure them. The presence of one or more instructors during each exercise permits the student to make frequent reports of his determinations, and to receive much instruction as to the characteristics of the minerals. The knowledge thus acquired can be supplemented by visits to the museum.

The course in blowpipe analysis may be considered as auxiliary to the practical exercises in determinative mineralogy. In the latter the student is urged to rely chiefly on physical tests; in the former he is required to determine minerals by the aid of the blowpipe.

The mineralogical laboratory offers facilities for an advanced course in crystallography and in physical and microscopic mineralogy to a few students who may receive permission to pursue such a course.

GEOLOGY.—This subject is studied with special reference to the needs of the mining engineer. Within a radius of twenty miles the student meets and becomes acquainted with the rocks of the archæan, the palæozoic and mesozoic formations, and makes geological maps from his own field notes, paying attention to the lithological characters of the formations, as they are mainly non-fossiliferous. An extended practical course in lithology familiarizes the student with the rocks of importance to the mining engineer and enables him to determine them by sight. There are over 2000 specimens in the collection, embracing all the known species. The course in historic geology is illustrated by a cabinet of typical specimens. The course in economic geology supplements the above work by familiarizing the student with the geological horizon of all the valuable constituents of the earth's crust and the theories of their formation.

ASTRONOMY.—After studying the theory of the subject two thirds of the year are devoted to practical work in the observatory.

APPLIED MECHANICS.—This embraces hydraulics, a study of the steam engine and the mechanics of machines employed in mining and metallurgy.

SURVEYING.—A course extending over five terms offers practice in land, mine and geological surveying, leveling, topography, triangulation and railroad reconnaissance and location. It also includes practical work in drawing and map construction.

METALLURGY.—There are two courses of, together, about one hundred and forty lectures upon this subject, which extend throughout a year. In these the chief object kept in view is a clear presentation of the principles involved in the various metallurgical processes, looked upon as the

application to practice of the laws of chemistry, physics and mechanics. This is followed, in the case of each process, by a description of the more important examples of the plant and of the methods of conducting the process, and by indications concerning its economic features. In order to ensure that the student shall understand the fundamental principles of metallurgy, and shall become so familiar with them as to be able readily to apply them, he is required to solve a series of problems in which these principles are involved. Many of the problems are such as are likely to present themselves to the metallurgist in his current practice.

The metallurgical laboratory affords opportunity for special investigations in subjects connected with metallurgy to such advanced students as are competent to conduct them.

MINING.—This subject is covered by three courses. The first begins with the application of economic geology to the needs of the engineer, so that he can study and value mining properties, locate appropriately the necessary plant, and calculate the cost of production. It includes the discussion of faults and the means of finding faulted bodies, with practical problems. The subjects of blasting, timbering and winning deposits are applied to actual cases, as tunnel-driving, etc., and problems from practical data are solved by the students. The second course covers the subjects of underground and surface haulage; loading, unloading and stocking ores; pumping; ventilation; hygiene and mining law. A series of problems is given in each of these subjects to cover cases that meet the engineer in ordinary practice. The third course treats of the mechanical preparation of ores by the wet, dry, or magnetic methods, and especially of the preparation of anthracite coal.

The location of the University in the vicinity of the iron works of the Lehigh Valley, and especially of the extensive establishment of the Bethlehem Iron Company, affords unusual facilities for the practical study of iron metallurgy. The processes for the manufacture of spelter and oxide of

zinc may be studied at the Bethlehem Zinc Works. The facilities for the practical study of mining and economic geology are not excelled by those of any other institution in the country. The zinc mines at Friedensville, the paint ores of the Marcellus formation, and the brown hematite and slate deposits of the Lehigh Valley are in the immediate vicinity, while within easy reach by rail are the semi-bituminous and anthracite coal fields, the block and fossil iron ores of the Clinton measures, the iron mines at Cornwall, Pennsylvania, and the iron and zinc mines of New Jersey; together affording examples of nearly all the methods of winning and dressing valuable deposits. Numerous visits of inspection are made in connection with the work of the course, to familiarize the student with metallurgical and mining processes and afford data for practical examples and projects.

FRESHMAN CLASS.

FIRST TERM.

See page 59.

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

French.—Grammar and Reader (continued). (3) *German.*—Grammar and Reader (continued). (3)

Machine and Mining Drawing.—Tracings and blue prints. Sketches and working drawings of machine pieces. Interpretation of machine drawings by isometric sketches. General views from given details. Sections of stub-ends and valve passages. Intersection of boiler-flues. Empirical proportioning of machine parts. Graphical problems illustrating the direction and extent of throw in faults. (5)

Surveying.—Theory of chain and compass surveying. Computation of areas. Elements of leveling. (1)

English.—Rhetoric. Essays. (2)

Gymnasium. (2)

THE COURSE IN METALLURGY.

This course is arranged so that the subjects which prepare the student for practice in the field of metallurgy shall be completed at the end of four years, when the graduate will receive the degree of Bachelor of Science in Metallurgy (B.S.). By remaining a year longer, and taking the subjects laid down for the post-graduate year, the graduate in the course may obtain the degree of Engineer of Mines (E.M.).

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)

Physics.—Mechanics, Heat and Electricity. Lectures. (5)

French.—Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

Drawing.—General views of metallurgical plant and detailed sketches. (2)

Surveying.—Use of the Level and Transit. Surveys and maps of farms. Colored topography. (2)

English.—Essays.

Gymnasium. (2)

SECOND TERM.

Mathematics.—Differential and Integral Calculus: Olney and Courtenay. (4)

Mechanics.—Theory of motion, statics, energy, center of gravity, moment of inertia and general equations of motion. (4)

Chemistry.—Lectures and laboratory practice. Douglass and Prescott's Qualitative Analysis. (4)

Stoichiometry. (2)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Dictation. (2) Or *German.*—Grammar. Reading. Dictation. (2)

English.—Essays.

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Courtenay's Calculus and Wood's Analytical Mechanics. (2)

Strength of Materials.—Elasticity and strength of wood, stone and metals. Theory of beams, columns and shafts. (4)

Crystallography.—Lectures, with practical exercises in the determination of crystals. (2)

Assaying.—Including the assay by the dry methods of Gold, Silver, Antimony, Mercury, Lead, Iron and Tin ores. Laboratory work. Ricketts. (3)

Chemical Philosophy.—Cooke. (3)

French.—Readings. Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation class in both languages optional throughout the year.

Essays and Original Orations.

Gymnasium. (2)

SECOND TERM.

Metallurgy.—Metallurgical Processes. Furnaces. Refractory building materials. Combustion. Natural and artificial fuels. Metallurgy of Iron. (4)

Mineralogy.—Descriptive Mineralogy, with practical exercises in the determination of minerals: E. S. Dana. (3)

Blow-Pipe Analysis.—Lectures, with practice. Plattner, Brush, or Nason and Chandler. (1)

Chemistry.—Fresenius' Quantitative Analysis. (4) The following analyses are executed by the student:

1. Iron Wire (Fe)
2. Copper Ore (Cu)
3. Silver Coin (Au, Ag, Pb, Cu)
4. Zinc Ore (Zn) By both Gravimetric and Volumetric Methods.
5. Bronze (Cu, Sn, Zn, Pb)
6. Spiegeleisen (Mn)
7. Lead Ore (PbS)
8. Ilmenite (TiO_2)

9. Iron Ore (complete analysis)
10. Limestone (complete analysis)
11. Coal (Volatile Matter, Fixed Carbon, Ash, H_2O, S, P)

Steam Engine.—Holmes' Steam Engine. (3)

French.—Readings. Compositions. Lectures on French Literature. (2) Or *German.*—Readings. Compositions. Lectures on German Literature. (2)

Literature and History.

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Metallurgy.—Of Copper, Lead, Silver, Gold, Platinum, Mercury, Tin, Zinc, Nickel, Cobalt, Arsenic, Antimony and Bismuth. (5)

Blow-Pipe Analysis.—Practice. (1)

Lithology.—Williams' Lithology, with practical exercises in determining rocks. (3)

Mechanics of Machinery.—Weisbach-Herrmann. Hoisting machinery, accumulators, cranes. (2)

Chemistry.—Quantitative Analysis: Laboratory Work: Fresenius. (3) The following analyses are executed by the student:

12. Slag (complete analysis)
13. Pig Iron (complete analysis)
14. Carbon in Steel (Volumetric)
15. Nickel Ore (Ni, Co)
16. Gas Analysis.

Graphical Statics.—Graphical analysis of roof trusses and girders. (2)

Projects.—In Metallurgy. (1)

Gymnasium.

SECOND TERM.

Mining.—Mechanical Preparation of Ores. Coal Washing. Callon. Lectures. (2)

Geology.—Economic Geology. Lectures. Williams. (2)

Drawing.—Designing of furnaces and other metallurgical plant. (2)

Mechanics of Machinery.—Pumps, pumping-engines, blowing-engines, compressors and fans. (4)

Hydraulics.—Hydrostatics. Flow of water in pipes and channels. Hydraulic motors. (2)

Lectures on American and English Literature. (2)

Christian Evidences.—Lectures. (1)

Preparation of Thesis.

Gymnasium.

POST-GRADUATE YEAR.

FIRST TERM.

Mining.—Modes of occurrence of the useful minerals. Searching for mineral deposits. Examination of mining properties. Boring. Mining tools, machines and processes. Timbering and masonry. Methods of working. Callon. André. Lectures. (3)

Geology.—General geological definitions and principles. Dynamic geology. Dana. (2)

Drawing.—General views of mining plant and detailed sketches. (2)

Projects.—In geology and mining. (1)

Surveying.—Mine survey. Theory and practice, with construction of mine maps. Tunneling and shaft location. (2)

Astronomy.—Descriptive astronomy: Loomis. (3)

Surveying.—Triangulation. Leveling. Topographical surveys with transit and stadia. Topographical maps. (4)

SECOND TERM.

Mining.—Underground transportation. Hoisting, drainage and pumping. Ventilation and Lighting. Hygiene of mines. Mining law. (3)

Geology.—Historic geology. Dana. (2)

Surveying.—Geological survey: mapping and cross-sectioning. (2)

Drawing.—Designing of mining plant. (2)

Surveying.—Theory of railroad curves. Railroad reconnaissance and location. Survey of a line, with profile, map and estimate of cost. (4)

Astronomy.—Doolittle's Practical Astronomy, with observatory work. (2)

Preparation of Thesis.

THE COURSE IN MINING.

This course is designed so that the student who desires to pursue the practice of mining and ore-dressing, and who does not wish to take the full course, may be prepared for practice in four years, receiving the degree of Bachelor of Science in Mining (B.S.). By remaining a year longer, and taking the subjects laid down for the post-graduate year, the graduate in this course may obtain the degree of Engineer of Mines (E.M.).

This course is identical with the preceding up to the end of the Freshman year.

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)

Physics.—Mechanics, Heat and Electricity. Lectures. (5)

French.—Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

Crystallography.—Lectures, with practical exercises in the determination of crystals. (2)

Surveying.—Use of the level and transit. Surveys and maps of farms. Colored topography. (2)

English.—Essays.

Gymnasium. (2)

SECOND TERM.

Mathematics.—Differential and Integral Calculus: Olney and Courtenay. (4)

Mechanics.—Theory of motion, statics, energy, center of gravity, moment of inertia and general equations of motion. (4)

Chemistry.—Lectures and laboratory practice. Douglass and Prescott's Qualitative Analysis. (4)

Mineralogy.—Descriptive mineralogy, with practical exercises in the determination of minerals: E. S. Dana. (3)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Dictation. (2) Or *German.*—Grammar. Reading. Dictation. (2)

English.—Essays.

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Courtenay's Calculus and Wood's Analytical Mechanics. (2)

Strength of Materials.—Elasticity and strength of wood, stone and metals. Theory of beams, columns and shafts. (4)

Geology.—General geological definitions and principles. Dynamic geology. Dana. (2)

Lithology.—Williams' Lithology, with practical exercises in determining rocks. (3)

Surveying.—Triangulation. Leveling. Topographical surveys with transit and stadia. Topographical maps. (4)

French.—Readings. Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation class in both languages optional throughout the year.

English.—Essays.

Gymnasium. (2)

SECOND TERM.

Geology. — Historic and Economic Geology. Lectures. Dana. (4)

Blow-Pipe Analysis.—Lectures, with practice. Plattner, Brush, or Nason and Chandler. (1)

Surveying.—Geological survey: mapping and cross-sectioning. (2)

Steam Engine.—Holmes' Steam Engine. (3)

Surveying.—Theory of railroad curves. Railroad reconnaissance and location. Survey of a line, with profile, map and estimate of cost. (4)

French.—Readings. Compositions. Lectures on French Literature. (2) Or *German.*—Readings. Compositions. Lectures on German Literature. (2)

Literature and History.

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Mining.—Modes of occurrence of the useful minerals. Searching for mineral deposits. Examination of mining properties. Boring. Mining tools, machines and processes. Timbering and masonry. Methods of working. Callon. André. Lectures. (3)

Mechanics of Machinery. — Weisbach-Herrman. Hoisting machinery, accumulators, cranes. (2)

Astronomy.—Young's General Astronomy. (3)

Surveying.—Mine survey. Theory and practice, with construction of mine maps. Tunneling and shaft location. (2)

Assaying.—Including the assay by the dry methods of Gold, Silver, Antimony, Mercury, Lead, Iron and Tin ores. Laboratory Work. Ricketts. (3)

Drawing.—General views of mining plant and detailed sketches. (2)

Projects.—In Geology and Mining. (1)

Gymnasium.

SECOND TERM.

Mining.—Underground transportation. Hoisting, drainage and pumping. Ventilation and lighting. Hygiene of mines. Mining law. (3) Mechanical preparation of ores. Coal washing. (2)

Drawing.—Designing of mining plant. (2)

Mechanics of Machinery.—Pumps, pumping-engines, blowing-engines, compressors and fans. (4)

Hydraulics.—Hydrostatics. Flow of water in pipes and channels. Hydraulic motors. (2)

Lectures on American and English Literature. (2)

Christian Evidences.—Lectures. (1)

Preparation of Thesis.

Gymnasium.

POST-GRADUATE YEAR.

FIRST TERM.

Metallurgy.—Of Copper, Lead, Silver, Gold, Platinum, Mercury, Zinc, etc. (5)

Blow-Pipe Analysis.—Practice. (1)

Chemistry.—Qualitative Analysis: Laboratory Work: Fresenius. (3) The following analyses are executed by the student:

1. Iron Wire (Fe)
2. Copper Ore (Cu)
3. Silver Coin (Au, Ag, Pb, Cu)
4. Zinc Ore (Zn) By both Volumetric and Gravimetric methods.
5. Bronze (Cu, Sn, Zn, Pb)
6. Spiegeleisen (Mn)
7. Lead Ore (PbS)

Chemical Philosophy.—Cooke. (3)

Drawing.—General views of metallurgical plant and detailed sketches. (2)

Graphical Statics.—Graphical analysis of roof-trusses and girders. (2)

SECOND TERM.

Metallurgy.—Metallurgical Processes. Furnaces. Refractory building materials. Combustion. Natural and artificial fuels. Metallurgy of Iron. (4)

Chemistry.—Fresenius' Quantitative Analysis. (4) The following analyses are executed by the student:

8. Ilmenite (TiO_2)
9. Iron Ore (complete analysis)
10. Limestone (complete analysis)
11. Coal (Volatile Matter, Fixed Carbon, Ash, H_2O, S, P)
12. Slag (complete analysis)
13. Pig Iron (complete analysis)
14. Carbon in Steel (Volumetric)
15. Nickel Ore (Ni, Co)
16. Gas Analysis.

Stoichiometry. (2)

Drawing.—Designing of furnaces and other metallurgical plant. (2)

Projects.—In Metallurgy. (1)

Astronomy.—Doolittle's Practical Astronomy, with observatory work. (2)

Preparation of Thesis.

THE COURSE IN PHYSICS AND ELECTRICAL ENGINEERING.

In the arrangement of the details of this new course the object has been to provide for those who seek to fit themselves as Electrical Engineers a preliminary training as complete and broad as that given to the members of the other schools. The requirements for admission, the mathematical and English studies, the modern languages and other outside branches are the same as those in the other technical courses. To these have been added such portions of the Mechanical Engineering Course, with which this course is most closely allied, as are necessary to give the student a general but sufficiently accurate knowledge of machinery.

This preparation joined to the unusually full development of Physics—and especially of Electricity—will, it is thought, make a course sufficiently comprehensive and thorough for the proper training of candidates for this degree. The great success attending the large majority of the young men who have taken the one year's course in Electricity, in their subsequent electrical work, warrants the belief that this broader and more extended course will attain its object.

The main feature of this new course is the prominence given to the subject of Physics. This extends through three years, and while Electricity is specially developed the other branches, Elementary Mechanics, Heat and Light, are fully provided for. The opportunity is thus given to any one who wishes to acquire a more extensive knowledge of Physics than the University curriculum has heretofore offered. The student is well drilled in the theory by means of lectures and recitations, which carefully cover the whole subject, and he is required to go over the ground himself in the best of all schools—the working laboratory. Enough of work on each topic is given him to render him familiar with his subject. Much prominence is given to work that brings out the resources of the student himself, such as the construction of instruments and original investigation. He is encouraged to this and a regular portion of his time is set apart for this object.

It will be seen from the preceding statement that this course offers two great advantages: the thorough and extensive training of those intending to take part in the great development of Electric Science in the industrial field now going on and the facilities offered to those who wish to take a four years' course specially devoted to the whole branch of Physics.

The practical work of the Physical Laboratory is too extensive to allow of full details being given in the following arrangement of the course. The more important subjects developed may be mentioned here. In Mechanics, exact measurements, specific gravity, barometric leveling. In Heat, calorimetry and hygrometry. In Light, testing of

optical instruments, spectroscopic analysis and photometry. In Magnetism, study of laws of force, determination of moments of magnets and of horizontal components of intensity of earth's magnetism in absolute units. In Meteorology, observations for several months as taken in the U. S. Signal Service stations, with all the usual corrections and reductions; construction of charts; mapping curves; reports, etc. In Electricity, management of batteries, construction of instruments, electrical measurements, electrolysis and relation of electrical currents to heat and mechanical work; practical running and care and tests of dynamos; electric lighting, with photometric tests of arc and incandescent lamps; measurement of heat units given off by lamps, their resistance (hot and cold); energy consumed in lamps; spectroscopic tests of purity of carbons; study of telegraph and telephone and of the application of electricity to railways; visits to manufactories, working systems, electric railways, etc.

The degree of Electrical Engineer (E. E.) will be given to the graduates of this course.

FRESHMAN CLASS.

FIRST TERM.

See page 59.

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

Chemistry.—Lectures and Laboratory Practice. Douglass and Prescott's Qualitative Analysis. (2)

French.—Grammar and Reader (continued). (3) Or *German.*—Grammar and Reader (continued). (3)

Drawing.—Projection Drawing and Descriptive Geometry, Warren's Elementary Projection Drawing. (3)

English.—Rhetoric. Essays. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)

Mechanics, Sound and Heat.—(Theory, lectures and recitations.) (3)

Mechanics, Sound and Heat.—(Physical Laboratory.) (4)

Drawing.—Isometrical Drawing. Architectural Drawing. (2)

French.—Grammar. Reading. Or *German.*—Grammar. Reading. (2)

English.—Essays.

Gymnasium. (2)

SECOND TERM.

Mathematics.—Differential and Integral Calculus: Olney and Courtenay. (4)

Heat.—Continued. (Physical Laboratory.)

Magnetism.—(Recitations and Physical Laboratory.) (3)

French.—Grammar. O'Connor. Choix de Contes Contemporains. Dictation. (2) Or *German.*—Grammar. Reading. Dictation. (2)

Mechanics.—Theory of motion, statics, energy, center of gravity, moment of inertia and general equations of motion. (4)

Steam Engine.—Holmes' Steam Engine. (3)

English.—Essays.

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Courtenay's Calculus and Wood's Analytical Mechanics. (2)

French.—Readings. Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation class in both languages optional throughout the year.

Light and Electricity, Static and Voltaic.—(Theory; text-books and lectures.) (3)

Light and Electricity, Static and Voltaic.—(Physical Laboratory.) (3)

Meteorology.—Text-book and practice. (1)

Strength of Materials.—Elasticity and strength of wood, stone and metals. Theory of beams, columns and shafts. (4)

Boilers.—Wilson. Strength, construction and wear and tear of boilers. (1)

Essays and Original Orations.

Gymnasium. (2)

SECOND TERM.

Dynamic Machines and Electric Lighting.—Theory; text-books and lectures. (3)

Dynamic Machines.—(Physical Laboratory.) (2)

Electric Lighting.—(Physical Laboratory.) (3)

French.—Readings. Compositions. Lectures on French Literature. (2) Or *German.*—Readings. Compositions. Lectures on German Literature. (2)

Machine Design.—Calculations for a High-Speed Steam Engine. Proportioning of such machine parts as come under the head of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers and connecting rods. (5)

Literature and History. (1)

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Applications of Electricity to Railroad, Telegraph and Telephone Systems, etc.—Theory; text-book and lectures. (2) (Physical Laboratory.) (5)

Machine Design.—Proportioning of Machine Parts (continued). (2)

Astronomy.—Young's General Astronomy. (3)

Graphical Statics of Mechanism.—Herrman-Smith. (2)

Scientific Readings.

Gymnasium.

SECOND TERM.

Applications of Electricity (continued). (3)

Measurement of Power.—Indicating of Steam Engines; dynamometer experiments. (1)

Dynamic Machines.—(Physical Laboratory.) Tests of Efficiency in Generators and Motors, etc. (1)

Physics.—Original Investigation. (5)

Lectures on English and American Literature. (2)

Christian Evidences. (1)

Preparation of Thesis.—(With laboratory work.)

Gymnasium.

THE COURSE IN CHEMISTRY.

This course of study is designed to prepare students for the profession of the Chemist, in connection with metallurgical establishments, sugar refineries, gas works, superphosphate works, electrical machinery manufactories, mining companies, etc., and the general consulting and analytical work of the Professional Chemist. It is also well adapted for the preparation of teachers of chemistry and as a preliminary course to the study of medicine. It is eminently practical, the student's time being largely occupied by practical work in the large, well equipped and well ventilated chemical laboratories, which were completed in 1885 and constitute the best constructed building for this purpose in this country. The museum of chemistry contains large collections of specimens, for illustrating the lectures on theoretical and applied chemistry.

Theoretical Chemistry.—Instruction in this subject begins with lectures four times a week, in the first term of the Freshman year. These lectures are fully illustrated by experiments, colored diagrams, working drawings and lantern pictures and specimens from the museum. They include a general introduction to Theoretical Chemistry. and a description of the non-metallic and metallic elements and their compounds, the general subject of inorganic

chemistry. The students are required to take notes of the lectures, and to pass a written examination at the end of the term.

. In the second term of this year Stoichiometry and chemical problems and reactions are taught by recitations twice each week.

The study of Theoretical Chemistry is continued throughout the Sophomore year by recitations three times a week from Cooke's Chemical Philosophy and is concluded in the first term of Junior, by a course of lectures and recitations on Theoretical Organic Chemistry, four times a week. These lectures are illustrated by experiments and by specimens from the museum of Chemistry.

Written examinations are held at the close of each of the above courses.

ANALYTICAL CHEMISTRY.—Qualitative Analysis is taught in the second term of the Freshman year, by lectures, recitations and practical work in the Qualitative Laboratory, twelve hours of practical work per week being required. This laboratory is a large, well ventilated and well lighted room, and supplied with convenient working tables, vacuum filtration, hoods for noxious vapors, steam baths, gas and washing appliances and a commodious room for hydrosulphuric acid. Distilled water is delivered by faucet in this room and the other large laboratories. At the close of the term a practical examination is held in this subject.

After completing this course, Quantitative Analysis is pursued throughout the Sophomore and the first term of the Junior years. This subject is taught by lectures, recitations and practical work in the Quantitative Laboratory, which is equipped similarly to the Qualitative Laboratory, but is supplied in addition with apparatus for drying precipitates and residues, rooms for the chemical balances, for combustions, and for a reference library.

Twelve hours per week are required during the first term of the Sophomore year and fifteen hours during the second term of that year and the first term of the Junior year.

The course consists in Gravimetric and Volumetric Analyses, as applied to the substances given in the lists farther on, accuracy being required in the determination of each constituent.

At the close of each term written examinations are held upon the theory and practice of Quantitative Analysis.

Gas Analysis is taught by lectures and laboratory practice in the Gas Laboratory. This laboratory is supplied with full and complete apparatus for Gas Analysis, according to Bunsen's processes, as well as apparatus for some of the more rapid methods. Mixtures of gases are required to be analyzed by the students, within certain limits of error, and a written examination, on the theory and practice, is held at the close of the course.

Assaying.—The assaying of ores by furnace assay, together with gold and silver bullion analysis, by processes practiced in the United States Mint, is taught by lectures and practical work in the first term of the Junior year, nine hours of practical work per week being required. The course includes the assaying of ores of lead, tin, antimony, gold, silver and iron, coal, and gold and silver bullion.

The Assaying Laboratory is supplied with large working tables, twenty-nine crucible and two iron furnaces, and eight muffle furnaces, with adjoining rooms for balances, and gold and silver bullion analysis.

A certain accuracy of results and a written examination as regards theory and practice are required.

Organic Chemistry.—The practical work in this subject is performed in the second term of the Junior year, fifteen hours being required, with conferences and recitations each week. The laboratory for this work is equipped similarly to the Quantitative Laboratory, in addition being supplied with steam heat, cold water and air blast upon the working tables, and a full supply of apparatus for the various determinations and experiments, including combustion furnaces, furnaces for heating sealed tubes, mercury pump, Hoffman's, Dumas' and Meyers' apparatus for vapor densities, nitrometers, chemical balances, etc.

The course consists of determinations of specific gravities, melting points, boiling points, vapor densities, chlorine, bromine, iodine and sulphur of organic substances.

Combustion analysis, nitrogen determination, fractional distillation, and the preparation of several pure organic compounds and their analysis are included.

INDUSTRIAL CHEMISTRY.—A course of lectures is delivered upon this subject in the second term of the Senior year, illustrated by experiments, diagrams, lantern pictures and specimens from the museum of chemistry. The working laboratory for this subject contains an apparatus for making illuminating gas, an alcohol still, worm and doubler and a complete working model of a sugar refinery, including filters, vacuum pan and centrifugal. In connection with this laboratory is a room containing a photometer and apparatus for determining the sulphur, ammonia and specific gravity of illuminating gas; also a laboratory for the testing of alcoholic liquors, sugar, molasses, bone black, soap, petroleum, paints, dyes, superphosphates and other commercial products, with the necessary technical apparatus. The students make practical experiments in this direction, and, with an instructor, visit various industrial establishments in this neighborhood and in and around New York City.

TOXICOLOGY.—A course of lectures on this subject is given in the first term of the Junior year, illustrated by experiments and by the large collection of specimens of poisons from the museum of chemistry. This is supplemented by a short course of laboratory work on some of the common poisons.

SANITARY CHEMISTRY.—During the second term of the Senior year attention is given to the qualitative and quantitative examination of air, water, food, disinfectants, and other subjects connected with this branch of the science. Special apparatus is provided for this work, as recommended by the best authorities on the subject.

PHOTOGRAPHIC CHEMISTRY.—A well equipped Photographic Laboratory and dark rooms are provided, in which the students of the chemical course receive practical instruction.

PHYSIOLOGICAL CHEMISTRY.—The examination of urine, blood, etc., receives a proper amount of attention.

The course also includes instruction in physics, mineralogy, blowpipe analysis, metallurgy and geology, which are of great value to the chemist.

MICROSCOPY.—Instruction in the use of the Microscope is given in the second term of the Senior year.

In the first term of the Senior year the student is required to prepare a Thesis on some subject, selected by the Professor of Chemistry, involving practical work in the laboratory in addition to the literary labor, each graduate thus making a contribution to the progress of the science, as a preliminary to the reception of his degree.

The graduate of this course receives the degree of Analytical Chemist (A.C.).

Students, not candidates for a degree, are admitted for special courses in Chemistry, of which they will receive certificates.

The laboratories are under the immediate charge of the Professor and Instructors of Chemistry and are open to the students from 8 o'clock A.M. to 6 o'clock P.M., including Saturdays. Students are at liberty to work in the laboratories beyond the required hours as their time may permit. Students are charged for materials and apparatus consumed; with moderate care this expense need not exceed $50 per year.

FRESHMAN CLASS.

FIRST TERM.

See page 59.

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

Chemistry.—Lectures and Laboratory Practice. Douglass and Prescott's Qualitative Analysis. (4)

French.—Grammar and Reader (continued). (3) Or *German.*—Grammar and Reader (continued). (3)

Stoichiometry. (2)

English.—Rhetoric. Essays. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Chemical Philosophy.—Cooke. (3)

Quantitative Analysis.—Fresenius' Quantitative Analysis. (4)

The following analyses are executed by the student:

1. Iron Wire (Fe)
2. Potassium Dichromate (Cr_2O_3)
3. Barium Chloride (Ba, Cl, H_2O)
4. Magnesium Sulphate (MgO, SO_3, H_2O)
5. Disodium Hydrogen Phosphate (P_2O_5)
6. Rochelle Salt (K_2O, Na_2O)
7. Volumetric Determination of Chlorine.
8. Acidimetry (HCl, H_2SO_4, HNO_3, $HC_2H_3O_2$)
9. Alkalimetry (KOH, NaOH, NH_4OH, Soda Ash, Pearl Ash.)
10. Chlorimetry (Bleaching Powders)

Quantitative Analysis.—Conference. (1)

Physics.—Mechanics, Heat and Electricity. Lectures. (5)

French.—Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

English.—Essays.

Gymnasium. (2)

SECOND TERM.

Physics.—Sound, Light and Meteorology. Lectures. (3)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Dictation. (2) Or *German.*—Grammar. Reading. Dictation. (2)

Quantitative Analysis.—Fresenius' Quantitative Analysis. (5)

The following analyses are executed by the student:

11. Copper Ore (Cu)
12. Zinc Ore (Zn) By both Gravimetric and Volumetric Methods.
13. Lead Ore (Pb, S)
14. Silver Coin (Au, Pb, Ag, Cu)
15. Spiegeleisen (Mn)
16. Copper Alloys (complete analysis)
17. Ilmenite (TiO_2)
18. Iron Ore (complete analysis)
19. Limestone (complete analysis)
20. Coal (Volatile Matter, Fixed Carbon, Ash, H_2O, S, P)
21. Slag (complete analysis)

Quantitative Analysis.—Conference. (1)

Blow-Pipe Analysis.—Lectures, with Practice. Plattner, Brush, or Nason and Chandler. (1)

Chemical Philosophy. (3)

English.—Essays.

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Toxicology.—Lectures. (2)

Quantitative Analysis.—Fresenius' Quantitative Analysis. (5)

The following analyses are executed by the student:

22. Guano (NH_3, P_2O_5, H_2O)
23. Clay (complete analysis)
24. Manganese Ore (MnO_2)
25. Mineral Water (complete analysis)
26. Pig Iron (complete analysis)
27. Nickel Ore (Ni, Co)
28. Carbon in Steel (Volumetric)
29. Gas Analysis.

Quantitative Analysis.—Conference. (1)

Organic Chemistry.—Lectures and Recitations. (4)

Crystallography.—Lectures, with practical exercises in the determination of crystals. (2)

French.—Readings. Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation class in both languages optional throughout the year.

Essays and Original Orations.

Gymnasium. (2)

SECOND TERM.

Organic Chemistry.—Laboratory. (5)

Organic Chemistry—Conference. (1)

Metallurgy.—Metallurgical Processes. Furnaces. Refractory Building Materials. Combustion. Natural and Artificial Fuels. Metallurgy of Iron. (4)

French.—Readings. Compositions. Lectures on French Literature. (2) Or *German.*—Readings. Compositions. Lectures on German Literature. (2)

Mineralogy.—Descriptive Mineralogy, with practical exercises in the determination of minerals, E. S. Dana. (3)

Literature and History. (1)

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Metallurgy.—Of Copper, Lead, Silver, Gold, Platinum, Mercury, Tin, Zinc, Nickel, Cobalt, Arsenic, Antimony and Bismuth. (5)

Assaying.—Including the Assay by the dry methods of Gold, Silver, Antimony, Lead, Iron and Tin ores, Coal, Gold and Silver Bullion and rich Lead. Ricketts. (3)

Organic Chemistry.—Laboratory. (5)

Geology.—Williams' Lithology, with practical exercises in determining rocks. (3)

Preparation of Thesis.

Gymnasium.

SECOND TERM.

Industrial Chemistry.—Lectures. (3)
Industrial Chemistry.—Laboratory. (5)
Agricultural Chemistry.—Laboratory. (1)
Sanitary Chemistry.—Laboratory. (1)
Microscopy.—Laboratory. (1)
Geology.—Historic and Dynamic Geology. Lectures. Geikie. (2)
Christian Evidences.—Lectures. (1)
Lectures on American and English Literature. (2)
Gymnasium.

THE COURSE IN ARCHITECTURE.

The studies in this course are closely allied with those in civil engineering, the higher surveying, railroad work, mineralogy, geology and astronomy being omitted, instead of which architectural drawing and designing is substituted as seen in the following program. Instruction is also given in the history and æsthetics of architecture, in methods of heating and ventilating, in boilers and hoisting machinery, and in house drainage and sewerage.

During the first and second years the student lays the foundation for his professional work by the study of Mathematics, Physics, Mechanics, Drawing, Surveying, English, and French or German. The course in drawing includes the use of water colors, free-hand, projection and isometric drawing, and their application to the general plans for a small building. In surveying there is field practice in the use of instruments, and also map drawing, thus enabling the student to understand the application of the subject to landscape gardening, and to the location of buildings.

During the third and fourth years of the course the work is of a more professional character. The subject of construction familiarizes the student with brick, stone, cement

and other materials, with foundations and masonry, with arches, piers and walls, and with the stone-cutter's art. There is a full course in the theory and calculation of columns, beams and shafts, in the strength of materials and its application to roof trusses and bridges. Working drawings of arches, piers and roof trusses are made in detail. Plans and estimates are prepared for wooden, brick, stone and iron buildings, the work being done according to standard specifications. In connection with the course visits of inspection are made to the numerous engineering structures in the Lehigh Valley and vicinity.

The student who completes all the subjects of this course will receive the degree of Bachelor of Science in Architecture (B. S.).

FRESHMAN CLASS.

FIRST TERM.

See Page 59.

SECOND TERM.

Mathematics.— Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

Surveying.— Theory of Chain and Compass Surveying. Computation of Areas. Elements of Leveling. (1)

French.—Grammar and Reader (continued). (3) Or *German.* —Grammar and Reader (continued). (3)

Drawing.— Projection Drawing and Descriptive Geometry. Drawings and Sketches from measurements of Objects. (4)

English.—Rhetoric. Essays. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.— Analytical Geometry: Olney's General Geometry. (4)

Physics.—Mechanics, Heat, and Electricity. Lectures. (5)

French.—Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

Drawing.—Isometric Drawing and Sketching. Architectural Drawing. Plans for a simple cottage. (2)

Surveying.—Use of the Compass, Level and Transit. Surveys and Maps of Farms. Colored Topography. (2)

English.—Essays.

Gymnasium. (2)

SECOND TERM.

Mathematics.—Differential and Integral Calculus: Olney and Courtenay. (4)

Physics.—Sound, Light and Meteorology. Lectures. (3)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Dictation. (2) Or *German.*—Grammar. Reading. Dictation. (2)

Mechanics.—Theory of motion, statics, energy, center of gravity, moment of inertia and general equations of motion. (4)

Surveying.—Profiles and Contour Maps. Hydrographic and City Surveying. Use of the Plane Table. Topographical Drawing and Sketching. (3)

English.—Essays.

Gymnasium.

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Courtenay's Calculus, and Wood's Analytical Mechanics. (2)

French.—Readings. Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation class in both languages optional throughout the year.

Strength of Materials.—Elasticity and Strength of Wood, Stone and Metals. Theory of Columns, Shafts and Beams. Reports on the Testing of Materials. (4)

Construction.—Materials of Construction. Masonry. Foundations. Construction of Roads and Pavements. (2)

Drawing. — Shades, Shadows and Linear Perspective. Sketches and Designs for Ornaments and Simple Details. (6)

Essays and Original Orations.

Gymnasium. (2)

SECOND TERM.

French.— Readings. Compositions. Lectures on French Literature. (2) Or *German.* — Readings. Compositions. Lectures on German Literature. (2)

Roofs and Bridges. — Theory and Calculation of Strains in Roof and Bridge Trusses. Graphical Statics. (3)

Construction.— Stone Cutting, with practical Drawings. (2) Theory of Retaining Walls and Stone Arches. Designs for Piers and Stone Arches. (2)

Architecture.— Designs and Estimates for Brick and Stone Buildings. (5)

History.— The History of Architecture. (2)

Literature and History. (1)

Gymnasium. (2)

SENIOR YEAR.

FIRST TERM.

Roofs and Bridges. — Cantilever, Suspension and Arch Bridges. Designs for Plate Girders and Riveted Roof Trusses. (6)

Mechanics of Machinery.— Pile drivers, cranes and elevators. (2)

Boilers. — Strength, construction, and wear and tear of boilers. Wilson. (1)

Architecture. — Specifications and Estimates. Design for an Iron Building. (5)

Heating and Ventilation.— Systems of heating, lighting and ventilating buildings. (2)

Gymnasium.

SECOND TERM.

Hydraulics. — Efflux of Water from orifices, and flow in pipes and channels. Hydraulic Motors. (2)

Sanitary Engineering. — Collection, Purification and Distribution of Water. Systems of Water Supply. The combined and the separate System of Sewerage. Drainage and Sewerage Buildings. (4)

Roofs and Bridges.—Design for a Pin-connected Roof Truss, with Working Drawings. (3)

Architecture.—Building Superintendence. The Æsthetics of Architecture. Original Plans, Estimates and Specifications. (4)

Lectures on English and American Literature. (2)

Christian Evidences.—Lectures. (1)

Preparation of Thesis.

Gymnasium.

PHYSICAL CULTURE.

The Gymnasium is open morning, afternoon and evening, in all, 45 hours a week. Exercise in it is required of all students who are fitted to take it. Class drill with the Instructor and individual exercise are prescribed.

GRADUATING THESES.

Every student will be required to present a thesis upon some topic connected with his special course, as a necessary portion of the exercises for his final examination for a diploma. These theses shall be accompanied by drawings and diagrams, when the subjects need such illustration. The originals will be kept by the University, as a part of the student's record, for future reference; but a copy may be retained by the student, and be published, permission being first obtained from the President.

DIPLOMAS AND CERTIFICATES.

The Diploma is given only to those who have passed all the examinations in a regular course and is signed by the Secretary of the Board of Trustees and by the Faculty of the University. For all the partial courses a certificate is given, signed by the Secretary of the Faculty, and showing what the student has accomplished.

GRADUATE STUDENTS.

Graduate students wishing to remain a year or more and pursue a course of study as candidates for another Degree may do so with the sanction of the Faculty. Those wishing to take *special* courses of study will be afforded every facility for so doing.

POST-GRADUATE DEGREES.

M. A.

The Faculty will recommend for the Degree of Master of Arts any candidate, otherwise properly qualified, who, after taking at this University the Degree of Bachelor of Arts, shall pursue, for at least one year at this University, or two years elsewhere, a course of liberal study prescribed by the Faculty in at least two departments, pass a thorough examination in the same and present a satisfactory Thesis.

M. S.

The Faculty will recommend for the Degree of Master of Science any candidate, otherwise properly qualified, who, after taking at this University the Degree of Bachelor of Science, or any Degree in the School of Technology, shall pursue, for at least one year at this University, or two years elsewhere, a course of study prescribed by the Faculty in at least two departments, pass a thorough examination in the same and present a satisfactory Thesis.

Ph. D.

The Faculty will recommend for the Degree of Doctor of Philosophy any candidate, otherwise properly qualified, who, after taking at this University the Degree of Master of Arts or Master of Science, shall pursue, for at least one year at this University, or two years elsewhere, a course of advanced study prescribed by the Faculty, in at least two departments, pass a thorough examination in the presence

of the Faculty in the same and present a satisfactory Thesis giving evidence of original investigation.

The candidate shall have a good knowledge of Latin and either French or German.

The Theses presented by candidates for Post-Graduate Degrees shall be retained by the University.

Applicants for any of these degrees will be required to complete the prescribed work within the allotted time. Special action of the Faculty is required for any extension of time.

THE UNIVERSITY LIBRARY.

The Library building was erected by the Founder of the University in 1877, at a cost of One Hundred Thousand Dollars, as a memorial of his daughter, Mrs. Lucy Packer Linderman, and during the same year more than Twenty Thousand Dollars were contributed by her family and friends as a memorial fund for the purchase of books. By the will of the Founder of the University a fund of $500,000 has been given for the permanent endowment of the library.

The building is semi-circular in plan, with a handsome façade in the Venetian style of architecture. It is constructed of Potsdam sandstone with granite ornamentation. In the interior, the center is occupied as a reading space, fifty by forty feet, from which radiate the book cases, extending from floor to ceiling; two galleries affording access to the upper cases. Shelf room is now provided for one hundred and sixty thousand volumes. The building is thoroughly fireproof, well lighted, and heated by steam.

Seventy-nine thousand volumes are now upon the shelves, including many extremely valuable works. The list of periodicals numbers about one hundred and twenty-five, embracing as far as possible all departments of knowledge.

The Library is conducted strictly for consultation, and is open to the use of the public; both of which conditions are in accord with the terms of the gift.

REGULATIONS OF THE LEHIGH UNIVERSITY LIBRARY.

I. The Library is open every day, except Sundays and Legal Holidays, from 8 A.M. until 10 P.M., and on Sundays for the students and others connected with the University from 1.30 P.M. until 9.30 P.M.

II. Admission is free to all persons over 16 years of age.

III. Readers are required to write their names and addresses in the Daily Register of the Library. They also write the name of the book desired upon a Library Card, with their signatures, and present the same to the Director's Clerk, who supplies the book, retaining the card as a receipt. Before leaving the Library, readers return their books to the clerk, and receive their cards.

IV. The University Professors and Instructors, only, are allowed to take books from the Library Building.

V. No person is allowed to enter the alcoves, or remove any book from the shelves, without permission of the Director.

VI. Readers wishing to consult the more valuable illustrated works make special application for that purpose.

VII. In taking notes, pencils, and not pens and ink, are to be used.

VIII. Audible conversation and the use of tobacco are strictly forbidden in any part of the Library.

IX. Any person not conforming to these Regulations, will be denied the privilege of the Library.

X. Any person who defaces, in any way, any book, magazine or paper, or the furniture, or any portion of the building, in addition to being deprived of the privileges of the Library will be prosecuted according to law.

OBSERVATORY.

By the liberality of Robert H. Sayre, Esq., one of the Trustees of the University, an Astronomical Observatory was erected on the University grounds, and placed under the charge of the Professor of Mathematics and Astronomy.

In the dome of the Observatory is mounted an Equatorial Telescope, of six inches aperture, by Alvin Clark & Sons. The west wing contains a superior Sidereal Clock, by Wm. Bond & Sons; a Zenith Telescope, by Blunt, and a Field Transit, by Stackpole. There is also a Prismatic Sextant, by Pistor & Martins.

Students in Practical Astronomy receive instruction in the use of the instruments and in actual observation.

The grounds upon which the Observatory stands, consisting of seven acres of land adjoining the original grant, were presented to the University by Charles Brodhead, Esq., of Bethlehem.

During the entire course the student will have ample opportunity to familiarize himself with the practical work of the Observatory and Computing Room.

THE PACKER MEMORIAL CHURCH

is the recent and munificent gift of Mrs. Mary Packer Cummings, daughter of the Founder of the University. It is a large and magnificent Church, richly furnished and handsomely appointed in every particular. There is no more beautiful Church edifice in the State and it is one of the noblest in all the land.

THE UNIVERSITY MUSEUM.

In addition to the large collection illustrating all branches of Industrial Chemistry, the Museum includes collections in Metallurgy, Geology, Zoölogy, and Archæology.

The Metallurgical Cabinet already includes specimens illustrating the various processes for obtaining the more common metals.

The Zoölogical Cabinet includes the Werner collection of nearly all the types of American birds with their nests and eggs, and the Packer collection of recent shells.

The Geological Cabinet numbers over ten thousand specimens and includes the Palæontological, Mineralogical, Petrographic and Economic collections. The first contains good specimens of nearly all the common genera. The

Mineralogical division includes the Keim and Rœpper collections—the latter being especially complete and valuable from a crystallographic standpoint. The Petrographic division numbers several thousand specimens and, besides including numerous varieties of nearly all the rocks of the globe, contains a duplicate set from the collection of the Second Geological Survey of this State. The Economic division was formed and donated by Dr. James P. Kimball, Director of the Mint, and formerly Professor of Economic Geology.

The Cummings Archæological Cabinet numbers three thousand specimens and includes Dr. Stubbs' collection of Indian relics, weapons, and utensils.

THE CHEMICAL AND NATURAL HISTORY SOCIETY OF THE LEHIGH UNIVERSITY.

This Society was organized in the Fall of 1871, as "The Chemical Society," but was afterwards expanded, as its present title indicates, and admits, by election, students from all departments of the University.

The collections of Botanical and Zoölogical Specimens belonging to the Society are already important. During the past years persons have been sent to Texas and Brazil to collect specimens for these cabinets.

The Society has organized and maintained several courses of public scientific lectures.

Among the honorary members of the Society are more than one hundred of the most distinguished scientists in Europe and the United States.

THE ENGINEERING SOCIETY.

This Society was organized in 1873, and admits, by election, students in the Junior and Senior Classes. Its meetings are held fortnightly. At these, papers relating to engineering subjects are read and discussed. It issues quarterly "The Journal of the Engineering Society," to which the members and others contribute.

THE MINING CLUB.

This was organized in 1883 and takes from the Junior, Senior and Post-Senior Classes those members of the Mining School who excel in their studies or in practical experience in the subjects of the course.

THE ELECTRICAL ENGINEERING SOCIETY

was organized in November, 1887, by students in the Advanced Course in Electricity. Its object is to supplement the regular work of the department by the study and discussion of electrical subjects.

THE AGORA

is a Literary Society which meets semi-monthly. Only students in the School of General Literature are eligible to membership.

THE ATHENÆUM

is also a Literary Society, whose active membership is confined to the Sophomore Class. The meetings are held weekly.

THE CLASSICAL CLUB.

This organization was formed in the Spring of 1889 by students in the Classical and Latin-Scientific Courses. At its monthly meetings, papers upon philological, historical and archæological subjects are read by students belonging to the upper classes and are then discussed and criticised. Thus independent work is encouraged and correct methods of investigation are acquired. Reports upon new discoveries and reviews of recent books vary the proceedings and keep the members informed in regard to the advances of philological science.

THE UNIVERSITY GUILD

is a Society for the promotion of the religious, mental, moral and social life of the students of the University. The Right Reverend, the Assistant Bishop of Central

Pennsylvania, is Honorary President and the Chaplain of the University, Honorary Vice-President. Its meetings are held fortnightly at the residence of the Chaplain. It is an active and flourishing society of important and growing influence.

THE NATURAL SCIENCE CLUB OF THE LEHIGH UNIVERSITY.

The object of this organization is systematic study, in connection with field work, in Natural History and its associated subjects. Its members are engaged in making a survey, both botanical and mineralogical, of the region within a radius of five miles from the University and propose to collect an herbarium and mineralogical cabinet which shall contain specimens of all the plants and minerals within this district.

FOUNDER'S DAY.

On the second Thursday of October of each year, Commemorative Exercises are held in honor of the Founder of the University.

Thursday, October 9, 1890, the Twelfth Founder's Day was celebrated. An address was delivered by George William Curtis, LL.D., of New York City.

UNIVERSITY SERMON.

This sermon is preached on the Sunday before University Day.

The Rev. George Williamson Smith, D.D., LL.D., President of Trinity College, was the preacher on Sunday, June 15, 1890, in the Memorial Church.

THESES.

Theses on the following subjects were prepared by the graduating class of 1890:

"Design of an Iron Highway Cantilever and Viaduct across the Lehigh River at Bethlehem."

THOMAS C. J. BAILY, JR.

"Investigation of the Standpipes and Small Reservoirs in Bethlehem and Allentown."

FREDERICK RICHARD BARRETT.

"Design for a Highway Bridge between Bethlehem and South Bethlehem at New Street."

EDWIN HERBERT BEAZELL.

"Plan for a Ship Canal Lock, especially for the Nicaragua Canal."

ADOLPH CARDENAS.

"Investigations in the Utilization and Recovery of certain matter in Sludge, a waste product of Petroleum Refineries."

WILLIAM PHELPS CLEVELAND.

"Comparison of a Plate Girder with a Stone Arch for a Span of Eighty Feet."

WARREN SCOTT COPE.

"Fabrication and Examination of Beer."

JAMES BARLOW CULLUM.

"The Theory of Bowstring Trusses."

JOHN WILLIAM DE MOYER.

"Investigation of a Seventy-seven-foot Through Plate Girder on the Allentown Terminal Railway."

CLEMENT HEYSER DETWILER.

"Design of a Through Plate Girder of Ninety Feet Span."

CHARLES EDWARD FINK.

"Design of an Iron Highway Cantilever and Viaduct across the Lehigh River at Bethlehem."

FREDERICK ELMER FISHER.

"Discussion of the Efficiency of a Six-inch Eureka Turbine."

FRANK ROBERTS FISHER.

"The Development of the Constitution and the Formation of Political Parties."

HOWARD AUGUSTUS FOERING.

"Determination of the Systematic Errors in Engineers' Transits."

RALPH GOODMAN.

"The Investigation and Review of two Locomotive Turntables."

GEORGE ELLSWORTH GREENE.

"The Economy in Reheating Compressed Air."

HARRY WALTER HARLEY.

"The Construction, Operation and Maintenance of the Lehigh Canal."

DAVID GARTH HEARNE.

"Discussion of the Colt Disc Engine."

FREDERIC KIDDER HOUSTON.

"Experiments upon the Efficiency of a Hydraulic Ram."

WILLIAM VINCENT KULP.

"Plan and Estimate for a System of Sewers for the City of Allentown, Pa."

HENRY MEYERS KURTZ.

"Distillation of Spirits."

THOMAS SMITH LEOSER.

"Manufacture of Rails in the United States."

JOHN ELMER LITCH.

"Investigations concerning the Manufacture and Estimation of domestic and foreign Glues."

CHARLES HERBERT MILLER.

"Plan for a Water Supply for the Lehigh University."

GEORGE NAUMAN, JR.

"Discussion of a Roof Truss at the Station of the C. R. R. of N. J. in Jersey City, N. J."

ROBERT ENGLER NEUMEYER.

"The Morris Canal of the State of New Jersey."

WILLIAM CASSIDY PERKINS.

"Plan for the Prevention of Floods in Washington City."

ASA EMORY PHILLIPS.

"Soluble Food and Lacto-Preparata."

CHARLES WILTBERGER PLATT.

"Review and Criticism of the Water Works at Sing Sing, N. Y."

ALEXANDER POTTER.

"Discussion of Ice Machinery, with an Estimate of a Plant for the Bethlehems."

EDWARD WILLIAMS PRATT.

"Wells Patent Balanced Compound Expansion Engine."

EDWIN JAY PRINDLE.

"Experiments on Dynamic and Static Stresses on Nails."

WALLACE CARL RIDDICK.

"Steam and Hot Water Heating Apparatus."

JOHN STOVER RIEGEL.

"A Comparison of the Methods used in the Manufacture of Illuminating Gas, as carried on in the cities of New York and Philadelphia."

JOSEPH EDGAR SANBORN.

"Review of the Sewerage System of Mt. Holly, N. J."

HARRY JOHNS SHERMAN.

"Review of the Suspension Bridge at Reading, Pa."

WILLIAM CALVIN SHOEMAKER.

"Preservation of Wood."

MICHAEL DRUCK SOHON.

"An Original Hydraulic Device for Controlling Side Rolls of Tire Mill."

WILLIAM ALSTON STEVENSON.

"Design of Three Spans of a Steel Highway Bridge."

THEODORE ALFRED STRAUB.

"Test and Discussion of a Steam Blower."

FRANCIS DUPONT THOMSON.

"Wire-Rope Tramways."

CHARLES COOKMAN TOMKINSON.

"Design of a City Highway Bridge of One Hundred and Twenty Feet Span."

CLAUDE ALLEN PORTER TURNER.

"History of Cantilever Bridges, with Theoretic Discussions."

AARON HOWELL VAN CLEVE.

"The Boynton Bicycle Railway."

JOSÉ RAMON VILLALON Y SANCHEZ.

"The Hunt Locomotive."

HERBERT WRIGHT.

THESES FOR THE DEGREE OF E. M.

"Experiments on the 'Champion' Ventilator."

JAMES W. ANDERSON, B.S.

"A Description of the Spiegel Furnace of the Lehigh Zinc and Iron Co., with a Discussion of the Heat Distribution within it."

FREDERICK LOUIS GRAMMER, B.S.

"A Comparison of the Firebrick and the Iron-pipe Hot-Blast Stoves."

ARNOLD KARTHAUS REESE, B.S.

"A Review of the Dorrance Colliery Fans."

CLARENCE WALKER.

"Method of Mining the Mammoth Bed at Lost Creek, Pa."

SAMUEL DEXTER WARRINER, B.A., B.S.

UNIVERSITY DAY.

This day is the last of the academic year and falls in 1891 on the third Wednesday in June. On this day orations are delivered by members of the graduating class, and degrees are conferred.

EXERCISES ON JUNE 19, 1890.

Reading of Scripture and Prayer by the Rt. Rev. N. S. Rulison, D.D., Assistant Bishop of the Diocese.

Salutatory Oration.—"The Indian Question."

HOWARD AUGUSTUS FOERING.

Oration.—"The Conflict of Science."

FRANK RAYMOND COATES.

Oration.—"The Effects of Machinery on the Laboring Classes."

EDWIN JAY PRINDLE.

Oration.—"In Rome, but not a Roman."
AARON HOWELL VAN CLEVE.

Valedictory Oration.
WILLIAM VINCENT KULP.

Award of the Wilbur Scholarship to
ALFRED EMORY LISTER,
of Carbondale, Pa., first in rank in the Sophomore Class.

The Wilbur Prizes were awarded as follows:

Freshman Class, Mathematics, to
HENRY BROWN EVANS, of Dayton, O.
WILLIAM IRVIN BOYD, of Washington, D. C.

Freshman Class, French, to
NATHANIEL MONTGOMERY OSBORNE, of Norfolk, Va.

Freshman Class, German, to
CHARLES JOSEPH O'NEILL, of Washington, D. C.

Freshman Class, English, to
ROBERT CULBERTSON HAYS HECK, of Heckton Mills, Pa.

Freshman Class, Freehand Drawing, to
HARRY JACOB ATTICKS, of Lisburn, Pa.
WILLIAM PRICE MARR, of Shamokin, Pa.

The following degrees were conferred:

E. M.

JAMES W. ANDERSON, B. S.,
FREDERICK LOUIS GRAMMER, B. S.,
ARNOLD KARTHAUS REESE, B. S.,
CLARENCE WALKER, B. S.,
SAMUEL DEXTER WARRINER, B. A.

B. S.

HOWARD AUGUSTUS FOERING.

C. E.

THOMAS C. J. BAILY, JR.,
FREDERICK RICHARD BARRETT,
EDWIN HERBERT BEAZELL,
ADOLPH CARDENAS,
WARREN SCOTT COPE,
JOHN WILLIAM DEMOYER,
CLEMENT HEYSER DETWILER,
FREDERICK ELMER FISHER,
FRANK ROBERTS FISHER,
RALPH GOODMAN,
GEORGE ELLSWORTH GREENE,
DAVID GARTH HEARNE,
WILLIAM VINCENT KULP,
HENRY MEYERS KURTZ,
GEORGE NAUMAN, JR.,
ROBERT ENGLER NEUMEYER,
WILLIAM CASSIDY PERKINS,
ASA EMORY PHILLIPS,
ALEXANDER POTTER,
WALLACE CARL RIDDICK,
HARRY JOHNS SHERMAN,
WILLIAM CALVIN SHOEMAKER,
THEODORE ALFRED STRAUB,
CLAUDE ALLEN PORTER TURNER,
AARON HOWELL VAN CLEVE,
JOSÉ RAMON VILLALON Y SANCHEZ.

M. E.

HARRY WALTER HARLEY,
FREDERIC KIDDER HOUSTON,
JOHN ELMER LITCH,
EDWARD WILLIAMS PRATT,
EDWIN JAY PRINDLE,
JOHN STOVER RIEGEL,
WILLIAM ALSTON STEVENSON,
FRANCIS DUPONT THOMSON,
CHARLES COOKMAN TOMKINSON,
HERBERT WRIGHT.

B. S.

(In Mining and Metallurgy.)

FRANK RAYMOND COATES,
CHARLES ELLERY COXE,
HARRY KINZER LANDIS,
SAMUEL DEXTER WARRINER, B. A.

A. C.

WILLIAM PHELPS CLEVELAND,
JAMES BARLOW CULLUM,
THOMAS SMITH LEOSER,
CHARLES HERBERT MILLER,
CHARLES WILTBERGER PLATT,
JOSEPH EDGAR SANBORN,
MICHAEL DRUCK SOHON.

The Benediction was then pronounced by the Bishop.

THE WILBUR SCHOLARSHIP.

This Scholarship was founded in 1872 by E. P. Wilbur, Esq., of South Bethlehem, and is the sum of $200 awarded annually to the student in the Sophomore Class having the best record.

THE ALUMNI SCHOLARSHIP.

The Alumni Association of the University has established a Scholarship of the value of $250 per annum, subject to the following conditions:

1. That the Scholarship shall only be awarded to a student in need of it.

2. That the Scholarship shall not apply to the first year of any student's course; he must without this aid have gone through one year, and must be prepared to start the second year free from all conditions.

3. That the Scholarship shall not be continued to a student who shall at any time during his course carry any condition over eight weeks beyond the date of the examination in which he failed.

Subject only to the above conditions the disposal of the fund shall until otherwise directed be in the hands of the President of the University.

THE HENRY S. HAINES MEMORIAL SCHOLARSHIP.

Mrs. Henry S. Haines, of Savannah, Ga., has established a scholarship of the annual value of $200 which is to be devoted to the support at the Lehigh University, throughout his scholastic career, of one student in the School of Mechanical Engineering; the selection to be made by Mrs. Haines herself during her life-time.

WILBUR PRIZES.

By the generosity of E. P. Wilbur, Esq., a fund has been established yielding an annual income of $100, for distribution in prizes as the Faculty shall determine.

ALUMNI PRIZES FOR ORATORY.

The "Alumni Association of the Lehigh University" has established an Annual Sum of Fifty Dollars, to be distributed as prizes for excellence in Oratory, subject to the following

REGULATIONS.

1. The Contest shall be held on the 22d day of February, or on the day designated by the University to commemorate the birthday of Washington.

2. There shall be a first prize of $25, a second of $15, and a third of $10.

3. To entitle one to be a competitor he must be a member of the Junior Class, taking a regular course.

4. Subjects for the oration shall be announced at the beginning of the first term of every year, and upon one of these each competitor shall write an oration not to exceed eight minutes in delivery.

5. Each oration shall bear upon its first page a fictitious name or motto, and shall be accompanied by a sealed envelope, which shall be superscribed with the same name or motto, and an address by which it may be reclaimed. The envelope shall contain the real name and address of the writer, with the declaration that the oration is his own original work. The examiner, having adopted a standard of excellence, may reject any or all of the orations presented which do not attain to this standard; of such as do —should they be sufficient in number—the best six shall be chosen, and their envelopes opened. The others shall be returned to the address given with their envelopes unopened.

6. The Executive Committee of the Alumni Association, or a committee of not fewer than three to be appointed by them, shall hear the competitors whose orations shall have been approved, and the awards shall be made by a majority of these judges.

7. In awarding the prizes the judges shall consider both the literary merits and the delivery of each oration.

8. These rules are subject to amendment by the Faculty.

The next contest will take place February 22, 1891.

ENTRANCE EXAMINATION PAPERS.

Used at the Examination in 1890.

[Requests for other examination papers than those herein printed can not be granted.]

I.—ENGLISH GRAMMAR.

1. Principal parts of *beat*, *burst*, *lie*, *enter*, *inter*, *pay*, *play*, *rid*, *wet*, *whet*.

2. Classify phrases according to form; according to office in the sentence.

3. What is essential to a complete sentence?

4. Illustrate the case absolute.

5. What is a clause? Name kinds of clauses.

6. Plurals of *path*, *motto*, *money*, *attorney*, *day*, *sky*, *handkerchief*, *sheaf*, *talisman*.

7. Correct or justify:

a. The general was seldom or ever found sober enough to lead his command.

b. There is no temptation so great but it can be resisted or shunned.

c. Here are fifty pens; you will find that either of them will do.

d. Then dash him to earth; there let him lay.

e. The legislature sets to-day.

f. O help me! I will drown, nobody shall help me!

g. Neither of them could read nor write.

h. It had never been my intention to have convoked the grand council.

i. It is not him you harm in your calumny.

8. Analyze this sentence fully, naming and classifying clauses and phrases. Parse words in italics:

It was *also* true *that* the Earl of Lauderdale, *who*, *both* from his high talents *and from* the long imprisonment which he had sustained *ever since* the battle of Worcester, had a peculiar *title to be consulted* on Scotch affairs, strongly advised the king that he should suffer his northern *subjects to retain* possession of their darling form of worship,

II.—GEOGRAPHY.

Outline maps of the Eastern part of the United States and Asia, respectively, were furnished to each applicant and he was required to draw the boundaries of countries, provinces, states and territories, and name them; to place and name the capital or chief city of each, and the principal rivers and mountain systems.

III.—UNITED STATES HISTORY.

1. How did the English failures in the settlement of America begin? When and where? and who was at the head of these expeditions?

2. What is said of Vermont? What name was first given to Vermont? Who claimed its soil? What do you know about the claim of New York? How was it resisted?

3. How long was the peaceable resistance to the taxing acts of Parliament kept up? How was resistance made? Who were the Whigs? Who were the Tories and why did the Tories join in the agreement?

4. Give the years in which John Adams' administration began and ended, and the leading events of his administration.

5. What is said of the Whig Party in England? Why and when was the name "Whig" adopted in the United States, and by whom was it adopted?

6. What were the great battles of 1862 in the East? In the West? What were the results of the year's operations?

7. When was the Tenure of Office Act passed? What did it forbid? Why and how did the President disobey it? Give the name of the President.

8. What is the Impeachment? What body tries impeachments? What vote is necessary for conviction? Where does the Chief Justice preside? What punishment follows conviction?

9. What power over taxes is given to Congress? What power in relation to commerce?

10. How are presidential electors chosen? And who are not to serve as electors?

IV.—ARITHMETIC.

1. (*a*) Give rules for multiplication and division of common fractions.

(*b*) Give rules for position of the decimal point in multiplication and division.

(*c*) How many inches in a foot? in a metre? How many inches in a link? How many chains in a mile? How many square rods in an acre?

2. Find the value of the following expression reduced to a decimal fraction:

$$\frac{1\frac{2}{3}-\frac{1}{2}^{7}+6}{\frac{1}{15}^{6}+10976}.$$

3. 5 miles 2 rods 3 feet $2\frac{1}{2}$ inches: how many kilometres? How many centimetres?

4. $16.75. Find interest, discount, and bank discount for 90 days at $3\frac{1}{2}$ per cent.

5. A can do a piece of work in 6 days, B in 7 days, and C in 10 days. A works $1\frac{1}{2}$ days, B $2\frac{1}{2}$ days. How long will it take C to finish it?

V.—GEOMETRY.

1. (*a*) What is a proposition? A theorem? A lemma? A corollary? An axiom? A postulate?

(*b*) When are two straight lines said to be perpendicular? When parallel?

(*c*) When is a polygon symmetrical with respect to a centre? With respect to an axis? What is the symmetrical figure of a straight line with respect to centre?

2. (*a*) Define similar polygons; the ratio of similitude of similar polygons. State the conditions which render two triangles similar.

(*b*) When is a straight line said to be divided harmonically? When in extreme and mean ratio?

(*c*) What is meant by the statement, "The angle at the centre is measured by the intercepted arc?" What is the unit surface? What is the maximum surface that can be enclosed by a given straight line.

3. If two parallel straight lines are cut by a third the alternate interior angles are equal, and conversely.

4. The three medial lines of a triangle pass through a common point.

5. On a given straight line construct a segment which shall contain a given angle.

6. The perpendicular from the vertex of the right angle to the hypotenuse is a mean proportional between the segments of the hypotenuse. Each side about the right angle is a mean proportional between the hypotenuse and the adjacent segment.

7. Construct a polygon which shall be similar to a given pentagon and equivalent to a given hexagon.

8. In terms of radius and apothem of a given regular polygon compute radius and apothem of a regular polygon of double the number of sides.

9. Of isoperimetric plane figures the circle has the maximum area, and conversely.

10. Any face-angle of a triedral angle is less than the sum of the other two.

VI.—ALGEBRA.

1. (*a*) Define algebra; an equation; root of an equation.

(*b*) Explain the process of dividing one fraction by another.

(*c*) State rule for finding lowest common multiple of quantities that are not readily factored.

2. (*a*) State how the sign of a root is determined.

(*b*) Give rule for finding highest common divisor when the quantities are not readily factored, and state the principles upon which it is based.

(*c*) Introduce the coefficients within the parentheses in the following:

$$a(b+c)^{\frac{1}{2}},\ a(b+c)^{2},\ a^{\frac{2}{3}}(b+c)^{\frac{3}{4}},$$

and state the principle involved.

3. (*a*) Explain the process of elimination by comparison.

(*b*) Define similar radicals, and state when a radical is in its simplest form.

(*c*) Define an arithmetical progression. State the relations (formulæ) among the parts of a geometrical progression.

4. Divide $\frac{x^3}{y^3}+\frac{5x^2}{12y^2}+\frac{39}{16}$ by $\frac{x}{3y^2}+\frac{1}{2y}$.

5. Reduce $\frac{x^3+y^3}{x^2-y^2}$, $\frac{a^4-16b^4}{a^3+8b^3}$, and $\frac{x^2+12x+18}{x+3}$ to simplest forms.

6. Extract the square root of 4.9 to three places, and explain the process.

7. Divide $1+\sqrt{-1}$ by $1-\sqrt{-1}$. Multiply $\sqrt{-x^2}$ by $\sqrt{-y^2}$.

Simplify $\frac{3}{\sqrt[3]{4}+\sqrt[4]{3}}$.

8. Solve $2\sqrt{b+x}-\sqrt{4a+x}=\sqrt{x}$; also

$$\sqrt{x+\sqrt{x}}-\sqrt{x-\sqrt{x}}=\frac{3}{2}\sqrt{\frac{x}{x+\sqrt{x}}}$$

9. Solve $\sqrt{a+x}+\sqrt{a-x}=\frac{12a}{5\sqrt{a+x}}$ also $\frac{8}{x^3}+2=\frac{17}{x^{\frac{3}{2}}}$.

10. Solve $\left.\begin{matrix}(x^2-xy=70)\\(xy-y^2=12)\end{matrix}\right\}$; $\left.\begin{matrix}(x+y=7)\\(x^2+2y^2=34)\end{matrix}\right\}$.

VII.—PHYSICS.

1. Define:

a. Kinetic Unit of Force.
b. Kilogram-meter.
c. Resultant Motion.
d. Joule.
e. Unit Quantity of Electricity.
f. Magnetic Field.
g. Wave Period.
h. Timbre or Quality.
i. Absolute Zero.
j. Ebullition.
k. Thermodynamics.
l. Diffraction.
m. Virtual Image.
n. Irradiation.

2. A piece of iron (sp. gr. 7.21) weighs 30 grams, what is its weight in turpentine (sp. gr. .87)?

3. With what velocity must a stone be projected vertically downward so that it will fall through 307.28 feet in 4 seconds?

4. What is the Peltier effect?

5. If the resistance of 1000 ft. of copper wire 5 mils in diameter is 431.7 ohms, what will be the resistance of 2000 ft. of iron wire 20 mils in diameter, iron having $\frac{1}{7}$ the conductivity of copper?

6. Describe a storage or secondary battery.

7. Ten cells each having an internal resistance of 4 ohms are arranged two abreast and the five pairs in series and give a current of $\frac{1}{3}$ ampere through an external resistance of 20 ohms; what is the E. M. F. of each cell?

8. A certain string vibrates 100 times per second. Find the number of vibrations of another string that is three times as long and weighing four times as much per foot and is stretched by double the weight.

9. Describe the sonometer.

10. What weight must drop from a height of 1000 ft. to convert 10 lbs. of ice at 15° F., into water at 60° F., if all the mechanical energy is converted into heat and applied to the ice? (Sp. ht. of ice .505.)

11. A kilogram of the vapor of alcohol at 80° C. passes through a copper worm placed in 10.8 kilograms of water at 12° C. the temperature of which is thereby raised to 36° C. The copper worm and the copper vessel in which the water is contained weigh together 3 kilograms. Required the latent heat of alcohol vapor. (Sp. ht. of copper .0939.)

12. How does the rapidity of evaporation vary?

13. How far must an arc lamp of 2000 c. p. be placed from a screen to give the same illumination as a 20 c. p. lamp at a distance of 3 ft.?

14. Describe the photographer's camera.

VIII.—LATIN.

I. Grammar.

1. Decline *poëma*, *domus*, *turris* and *filia*, marking the quantity of all penultimate and final vowels.

2. Give the demonstrative pronouns with the differences in meaning and use.

3. Decline *idem* and *alius* in all genders. Compare *gracilis* and *arduus*.

4. Mention the endings used in forming abstract nouns from adjectives. Form nouns from *malus* and *nobilis*.

5. Give the principal parts and inflect in the future indicative and present subjunctive active, *teneo*, *sto*, *gero* and *fio*, marking the quantity of all syllables. Give synopsis of *malo* in the second person singular. Also all the participles of *hortor*.

6. State the rules for the uses of the Ablative without a preposition. What cases follow *similis*, *recordor*, *sub*, *pareo?* Mention all the methods of expressing in Latin the purpose of an action. How are the supines used? After what verbs are two accusatives employed?

7. What feet are used in Vergil's Æneid and how are they arranged to form a verse? Explain the kinds of caesura.

II. Caesar.

Translate (*Bk. I*, 17):

Tum demum Liscus, oratione Caesaris adductus, quod antea tacuerat proponit: 'Esse nonnullos, quorum auctoritas apud plebem plurimum valeat, qui privatim plus possint, quam ipsi magistratus. Hos seditiosa atque improba oratione multitudinem deterrere, ne frumentum conferant, quod praestare debeant: si jam principatum Galliae obtinere non possint, Gallorum quam Romanorum imperia praeferre: neque dubitare [debeant] quin, si Helvetios superaverint Romani, una cum reliqua Gallia Haeduis libertatem sint erepturi.

Show how this may be changed into direct discourse. *Conferant* why subjunctive?

Translate (*Bk. IV*, 16):

Germanico bello confecto, multis de causis Caesar statuit sibi Rhenum esse transeundum; quarum illa fuit justissima quod, cum videret Germanos tam facile impelli ut in

Galliam venirent, suis quoque rebus eos timere voluit, cum intellegerent et posse et audere populi Romani exercitum Rhenum transire. Accessit etiam, quod illa pars equitatus Usipetum et Tencterorum, quam supra commemoravi praedandi frumentandique causa Mosam transisse, neque proelio interfuisse, post fugam suorum se trans Rhenum in fines Sigambrorum receperat, seque cum iis conjunxerat.

Give the construction of *sibi* and the principal parts of *audere*. Mention what events follow in this fourth book.

III. Cicero.

Translate (*Cat. II*, §3):

Ac si quis est talis, quales esse omnes oportebat, qui in hoc ipso, in quo exsultat et triumphat oratio mea, me vehementer accuset, quod tam capitalem hostem non comprehenderim potius quam emiserim, non est ista mea culpa, sed temporum. Interfectum esse L. Catilinam et gravissimo supplicio adfectum jam pridem oportebat, idque a me et mos majorum et hujus imperii severitas et res publica postulabat.

Why is *accuset* subjunctive?

Translate (*Cat. IV*, §14):

Sed ea quae exaudio, patres conscripti, dissimulare non possum. Jaciuntur enim voces, quae perveniunt ad aures meas, eorum qui vereri videntur ut habeam satis praesidii ad ea quae vos statueritis hodierno die transigunda. Omnia et provisa et parata et constituta sunt, patres conscripti, cum mea summa cura atque diligentia, tum multo etiam majore populi Romani ad summum imperium retinendum et ad communis fortunas conservandas voluntate.

What explanation is given of the title *patres conscripti?*

Did Cicero have the law on his side in the punishment of Catiline?

Translate (*Archias*, §14):

Nam nisi multorum praeceptis multisque litteris mihi ab adulescentia suasissem, nihil esse in vita magno opere expetendum nisi laudem atque honestatem, in ea autem persequenda omnis cruciatus corporis, omnia pericula mortis

atque exilii parvi esse ducenda, numquam me pro salute vestra in tot ac tantas dimicationes atque in hos profligatorum hominum cotidianos impetus objecissem.

Explain the subjunctives in this passage and the syntax of *parvi*.

Translate (*Manilian Law*, §53):

Quid? tum, per deos immortales! si plus apud populum Romanum auctoritas tua quam ipsius populi Romani salus et vera causa valuisset, hodie hanc gloriam atque hoc orbis terrae imperium teneremus? An tibi tum imperium hoc esse videbatur, cum populi Romani legati quaestores praetoresque capiebantur? cum ex omnibus provinciis commeatu et privato et publico prohibebamur? cum ita clausa nobis erant maria omnia, ut neque privatam rem transmarinam neque publicam jam obire possemus?

IV. Vergil.

Translate (*Bk. III*, *l.* 374):

Nate dea,—nam te majoribus ire per altum
Auspiciis manifesta fides: sic fata deum rex
Sortitur, volvitque vices; is vertitur ordo—
Pauca tibi e multis, quo tutior hospita lustres
Aequora et Ausonio possis considere portu,
Expediam dictis: prohibent nam cetera Parcae
Scire Helenum farique vetat Saturnia Juno.

Tell how this passage comes in the course of the narrative. Explain the proper names. Write out the third and fifth lines, marking off the feet and the caesuras.

Translate (*Bk. VI*, *l.* 398):

Quae contra breviter fata est Amphrysia vates:
'Nullae hic insidiae tales; absiste moveri;
Nec vim tela ferunt: licet ingens janitor antro
Aeternum latrans exsanguis terreat umbras,
Casta licet patrui servet Proserpina limen.
Troïus Aeneas, pietate insignis et armis,
Ad genitorem imas Erebi descendit ad umbras.
Si te nulla movet tantae pietatis imago,
At ramum hunc (aperit ramum, qui veste latebat) adgnoscas.'

V. Latin at Sight.

Translate:

Inde movit et pervenit ad oppidum Leptin, liberam civitatem et immunem. Legati ex oppido obviam veniunt, libenter se omnia facturos, quae vellet, pollicentur. Itaque centurionibus ad portas oppidi et custodiis impositis, ne quis miles in oppidum introiret aut injuriam faceret cuipiam incolae, non longe ab oppido secundum litus facit castra. Eodemque naves onerariae et longae nonnullae casu advenerunt; reliquae, ut est ei nuntiatum, incertae locorum Uticam versus petere visae sunt.—*De Bello Afr.* § *VII.*

VI. Latin Prose Composition.

On the following day they move their camp from that place. Cæsar does the same thing and sends ahead (*praemitto*) all his cavalry to the number of four thousand, which he had collected (*cogo*) from the entire province, to see in what direction (*pars*) the enemy are making their march (*iter*). These having followed the rear (*novissimum agmen*) too eagerly, engage in an unfavorable (*alienus*) place and a few of our men fall.

VII. Roman History.

1. Who were Camillus, Spurius Cassius, Coriolanus and Jugurtha?
2. Give an account of Hannibal's campaigns in Italy.
3. Who were the members of the two triumvirates and how did each die?
4. Give the career of Sulla with date and state what changes were made by him in the Roman Constitution.
5. Write a description of the civil troubles at the time of the Gracchi.

IX.—GREEK.

I. Grammar.

1. Write the following passage with proper breathings and accents:

και οστις τε υμων τους οικειους επιθυμει ιδειν, μεμνησθω ανηρ αγαθος ειναι. ου γαρ εστιν αλλως τουτου τυχειν. οστις τε ζην επιθυμει, πειρασθω νικαν. των μεν γαρ νικωντων το κατακαινειν, των δε ηττωμενων το αποθνησκειν εστιν.

2. Decline in the singular, *γέφυρα, μνᾶ, νεώς, ναῦς, κέρας*; in the plural, *σκιά, νοῦς, μήτηρ, ἵππεύς, γυνή, δόρυ.*

3. Compare the adjectives *φίλος, αἰσχρός, ταχύς, χαρίεις*, and decline the comparative of *ταχύς.*

4. Decline *οὗτος*; translate *of ourselves, to one another, the other* (of two), *of what kind?, whence?, then.*

5. Decline the Greek words for *one, four;* and translate *twenty times, twelfth.*

6. Give the principal parts of *γίγνομαι, τρέπω, βαίνω, στέλλω.*

7. Give the indicative in full and the synopsis (first form in each mood) of the aorist active and passive of *τίθημι.*

8. Inflect the pluperfect of *οἶδα*; the pluperfect (middle) of *τάττω.*

9. Name three classes of verbs that govern the genitive; five prepositions that govern the dative, with the meaning of each.

10. Translate *εἰς τὴν πόλιν ἀφικοίμην* and *εἰς τὴν πόλιν ἀφικοίμην ἄν*, and explain these two uses of the optative.

II. Xenophon.

Translate:

ὅσων δὲ δὴ καὶ οἵων ἂν ἐλπίδων ἐμαυτὸν στερήσαιμι, εἰ σέ τι κακὸν ἐπιχειρήσαιμι ποιεῖν, ταῦτα λέξω. ἐγὼ γὰρ Κῦρον ἐπεθύμησά μοι φίλον γενέσθαι, νομίζων τῶν τότε ἱκανώτατον εἶναι εὖ ποιεῖν ὃν βούλοιτο· σὲ δὲ νῦν ὁρῶ τήν τε Κύρου δύναμιν καὶ χώραν ἔχοντα καὶ τὴν σαυτοῦ σώζοντα· τὴν δὲ βασιλέως δύναμιν, ἣ Κῦρος πολεμίᾳ ἐχρῆτο, σοὶ ταύτην σύμμαχον οὖσαν. τούτων δὲ τοιούτων ὄντων τίς οὕτω μαίνεται, ὅστις οὐ βούλεται σοὶ φίλος εἶναι.

By whom was this said? to whom? when?

Explain the optatives *στερήσαιμι, ἐπιχειρήσαιμι, βούλοιτο*; the genitives *ἐλπίδων, τούτων*; the dative *ᾗ.*

Give the uncontracted forms of *ποιεῖν*, *ὁρῶ*, *ἐχρῆτο*.

Translate:

Ἐπεὶ δ' οἱ τελευταῖοι τῶν Ἑλλήνων κατέβαινον εἰς τὰς κώμας ἀπὸ τοῦ ἄκρου ἤδη σκοταῖοι, διὰ γὰρ τὸ στενὴν εἶναι τὴν ὁδὸν ὅλην τὴν ἡμέραν ἡ ἀνάβασις αὐτοῖς ἐγένετο καὶ ἡ κατάβασις εἰς τὰς κώμας, τότε δὴ συλλεγέντες τινὲς τῶν Καρδούχων τοῖς τελευταίοις ἐπέθεντο καὶ ἀπέκτεινάν τινας καὶ λίθοις καὶ τοξεύμασι κατέτρωσαν, ὀλίγοι ὄντες. ἐξ ἀπροσδοκήτου γὰρ αὐτοῖς ἐπέπεσε τὸ Ἑλληνικόν. εἰ μέντοι τότε πλείους συνελέγησαν, ἐκινδύνευσεν ἂν διαφθαρῆναι πολὺ τοῦ στρατεύματος.

Give the present forms of *συλλεγέντες*, *ἐπέθεντο*, *κατέτρωσαν*, *ἐπέπεσε*, *διαφθαρῆναι*, and state where each is made.

III. Xenophon, at Sight.

Χαιρεφῶντα δέ ποτε καὶ Χαιρεκράτην, ἀδελφὼ μὲν ὄντε ἀλλήλοιν, ἑαυτῷ δὲ γνωρίμω, αἰσθόμενος διαφερομένω, ἰδὼν τὸν Χαιρεκράτην, Εἰπέ μοι, ἔφη, ὦ Χαιρέκρατες, οὐ δήπου καὶ σὺ εἴ τῶν τοιούτων ἀνθρώπων οἱ χρησιμώτερον νομίζουσι χρήματα ἢ ἀδελφούς; . . . . καὶ ὁ Χαιρεκράτης εἶπεν· Ἀλλ' εἰ μέν, ὦ Σώκρατες, μὴ μέγα εἴη τὸ διάφορον, ἴσως ἂν δέοι φέρειν τὸν ἀδελφὸν καὶ μὴ μικρῶν ἕνεκα φεύγειν· ἀγαθὸν γὰρ, ὥσπερ καὶ σὺ λέγεις, ἀδελφὸς ὢν οἷον δεῖ· ὁπότε μέντοι παντὸς ἐνδέοι καὶ πᾶν τὸ ἐναντιώτατον εἴη, τί ἂν τις ἐπιχειροίη τοῖς ἀδυνάτοις;

γνώριμος, known.
διαφέρομαι, be at variance.
χρήσιμος, useful.
διάφορον, ground of quarrel.
ἐνδεῖν, lack.
ἐνάντιος, hostile.
ἐπιχειρεῖν, attempt.

IV. Homer.

Translate:

αἰσχρὸν γὰρ τόδε γ' ἐστὶ καὶ ἐσσομένοισι πυθέσθαι,
μὰψ οὕτω τοιόνδε τοσόνδε τε λαὸν Ἀχαιῶν
ἄπρηκτον πόλεμον πολεμίζειν ἠδὲ μάχεσθαι
ἀνδράσι παυροτέροισι, τέλος δ' οὔ πώ τι πέφανται.
εἴ περ γάρ κ' ἐθέλοιμεν, Ἀχαιοί τε Τρῶές τε,
ὅρκια πιστὰ ταμόντες ἀριθμηθήμεναι ἄμφω,
Τρῶες μὲν λέξασθαι ἐφέστιοι ὅσσοι ἔασιν,
ἡμῶν δ' ἐς δεκάδας διακοσμηθεῖμεν Ἀχαιοί,
Τρώων δ' ἄνδρα ἕκαστοι ἑλοίμεθα οἰνοχοεύειν,
πολλαί κεν δεκάδες δευοίατο οἰνοχόοιο,
τόσσον ἐγώ φημι πλέας ἔμμεναι υἷας Ἀχαιῶν

Τρώων, οἳ ναίουσι κατὰ πτόλιν. ἀλλ' ἐπίκουροι
πολλέων ἐκ πολίων ἐγχέσπαλοι ἄνδρες ἐνεισιν,
οἳ με μέγα πλάζουσι καὶ οὐκ εἰῶς' ἐθέλοντα
Ἴλιον ἐκπέρσαι, ἐὺ ναιόμενον πτολίεθρον.

Write the attic forms of *ἐσσομένοισι, ἀριθμηθήμεναι, ἔασιν, δεναίατο, πλέας, ἔμμεναι, πολλέων, πολίων.*

By whom were these lines spoken? on what occasion?

Translate:

ἡμέων δ' ὁπποτέρῳ θάνατος καὶ μοῖρα τέτυκται,
τεθναίη· ἄλλοι δὲ διακρινθεῖτε τάχιστα.
οἴσετε δ' ἄρν', ἕτερον λευκὸν ἑτέρην δὲ μέλαιναν,
γῇ τε καὶ ἠελίῳ· Διὶ δ' ἡμεῖς οἴσομεν ἄλλον.

Where is *τεθναίη* made? *διακρινθεῖτε*? *οἴσετε*?

Divide these four lines into feet, giving quantity of each syllable.

V. History.

1. Give a brief account of Draco; of Solon; of Cleon; of Lysander.

2. Where was Leuctra? When was the battle of Leuctra fought? Who were the combatants? What was the result?

3. Who was Kleisthenes? What did he do?

4. When did the Peloponnesian War begin? When did it come to an end? Where was the last battle fought? What were its results?

5. Give a brief account of the life of Demosthenes.

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